Aviation Week and Space Technology

February 13, 1961

SPECIAL REPORT:

Grumman Orbital Astronomical Observatory

First Minuteman Launch

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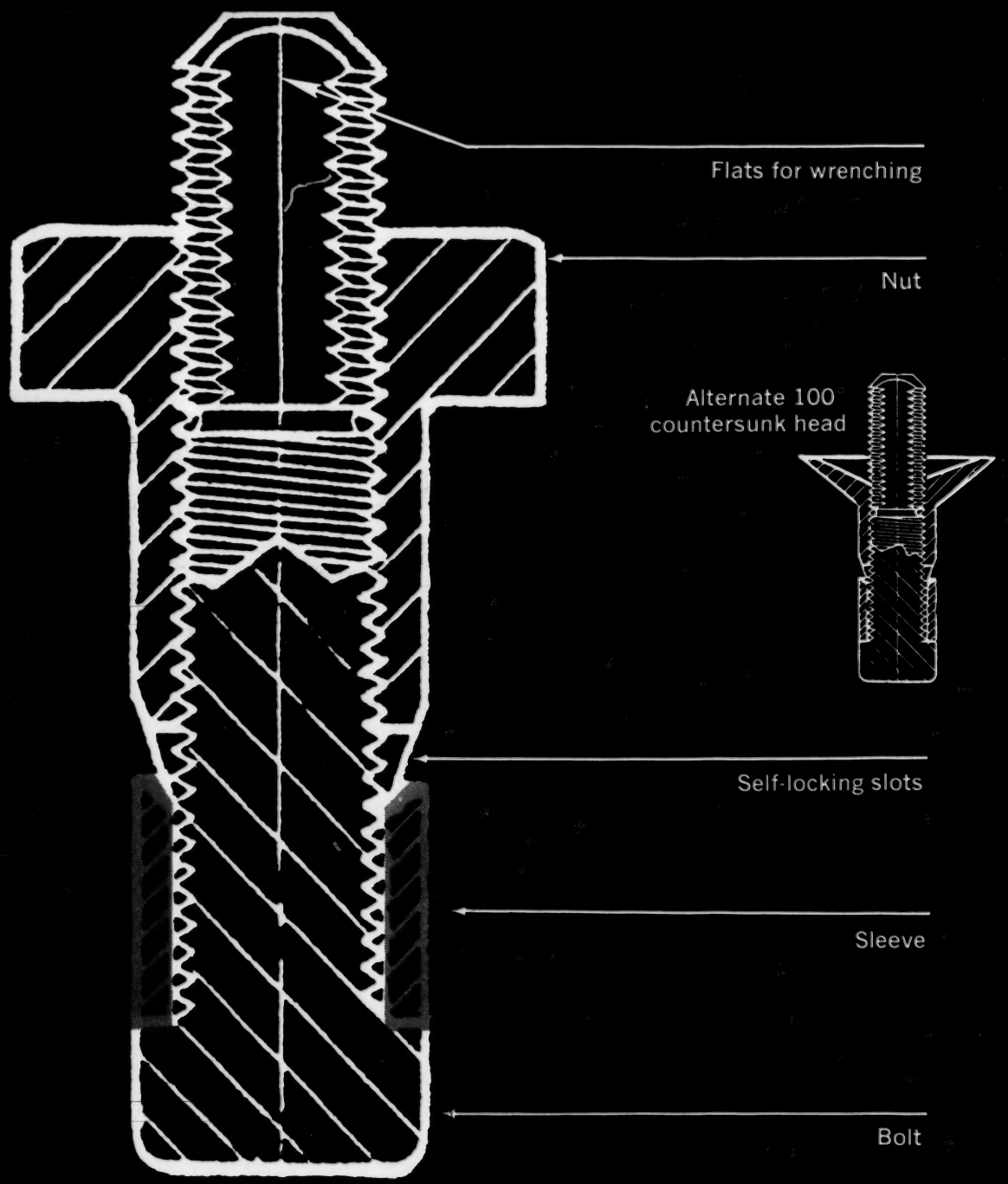

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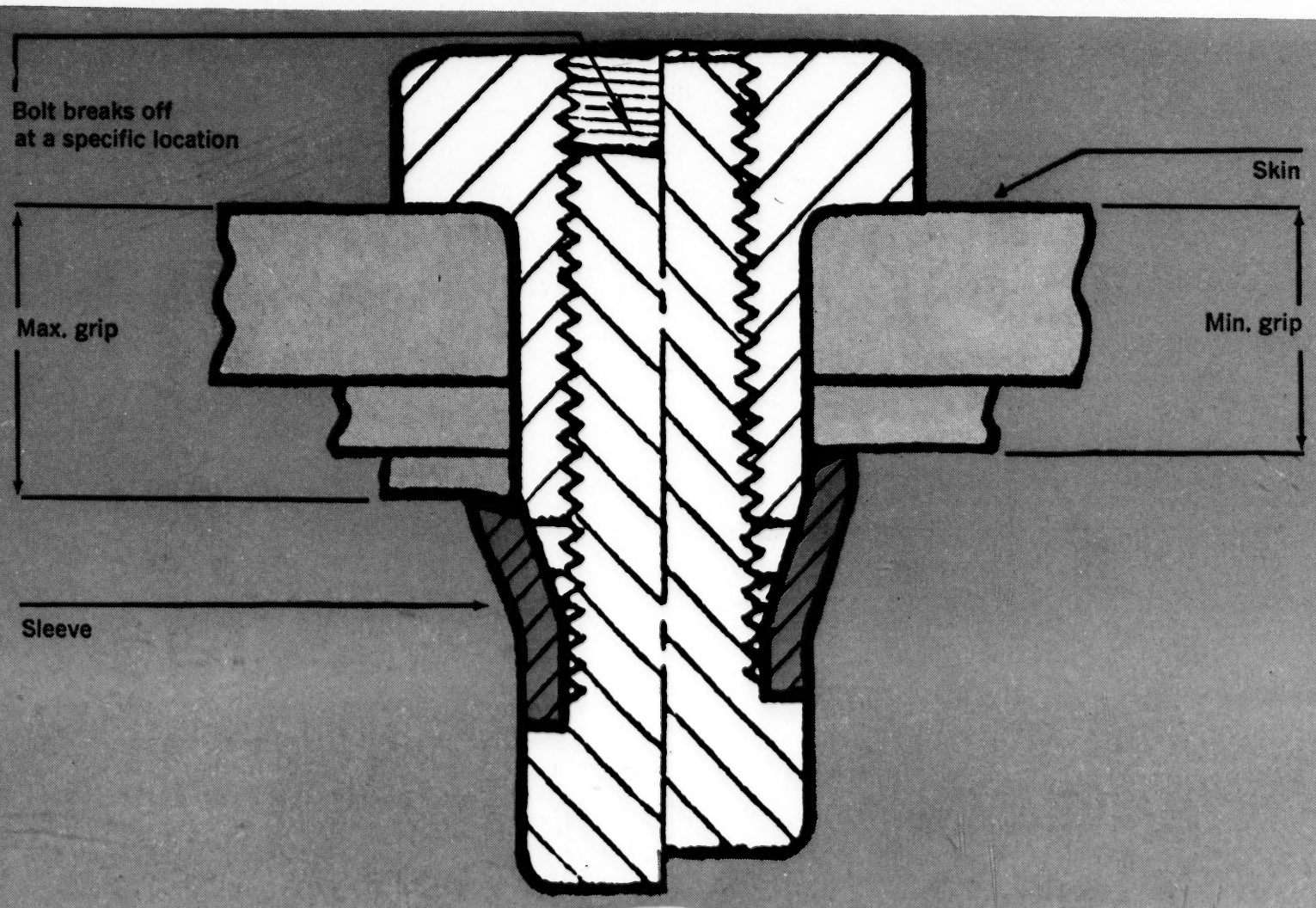

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AVIATION CALENDAR

Feb. 21-23—11th Annual Convention, International Airline Navigators Council, Hotel Manhattan, New York, N. Y.

Feb. 22—Second Annual Reliability Symposium, American Society for Quality Control, Statler Hilton, Los Angeles.

Feb. 26-28—Texas Agricultural Aviation Conference, Texas A & M College, College Station, Tex.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Missile and Space Vehicle Testing Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation/Space Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

(Continued on page 6)

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Vol. 74, No. 7

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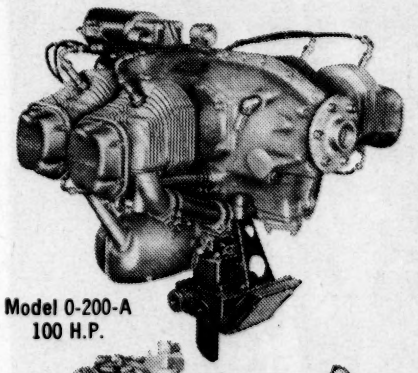

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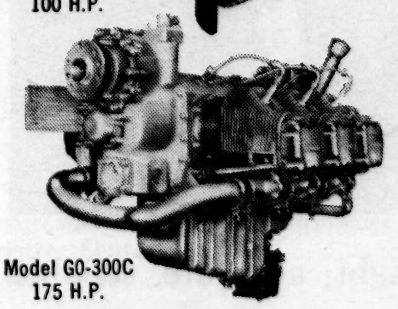

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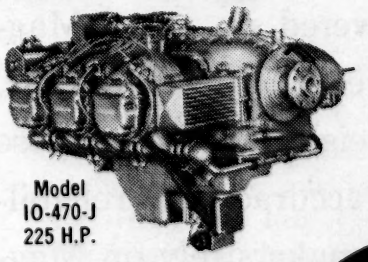

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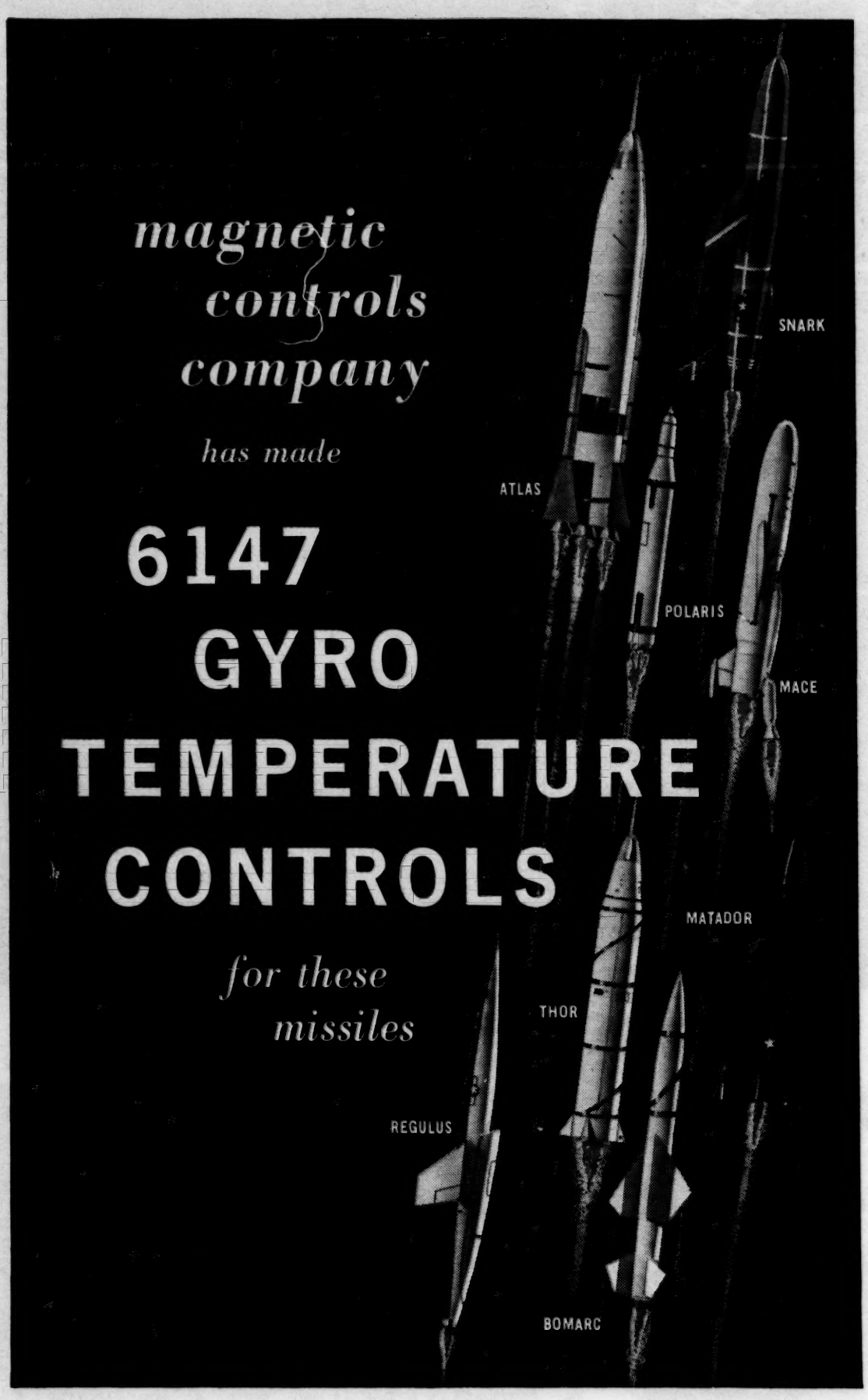

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AVIATION CALENDAR

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Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 10-14—International Symposium on Aviation Research and Development, Federal Aviation Agency, Atlantic City, N. J.

Apr. 13-14—Annual Meeting, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Business Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs, Colo.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 12-14—Mid-American Air Fair, Municipal Airport, Wichita, Kan.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

February 13, 1961

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COVER: Air Force Minuteman rises from pad during first free-flight launch of the three-stage, solid propellant intercontinental ballistic missile from Cape Canaveral, Fla., Feb. 1 (AW Feb. 6, p. 28). Minuteman traveled about 4,000 naut. mi. down the Atlantic Missile Range and met all test objectives. Flight was the first attempt to launch a complete missile in the initial test. Other Minuteman photos appear on pp. 88-89.

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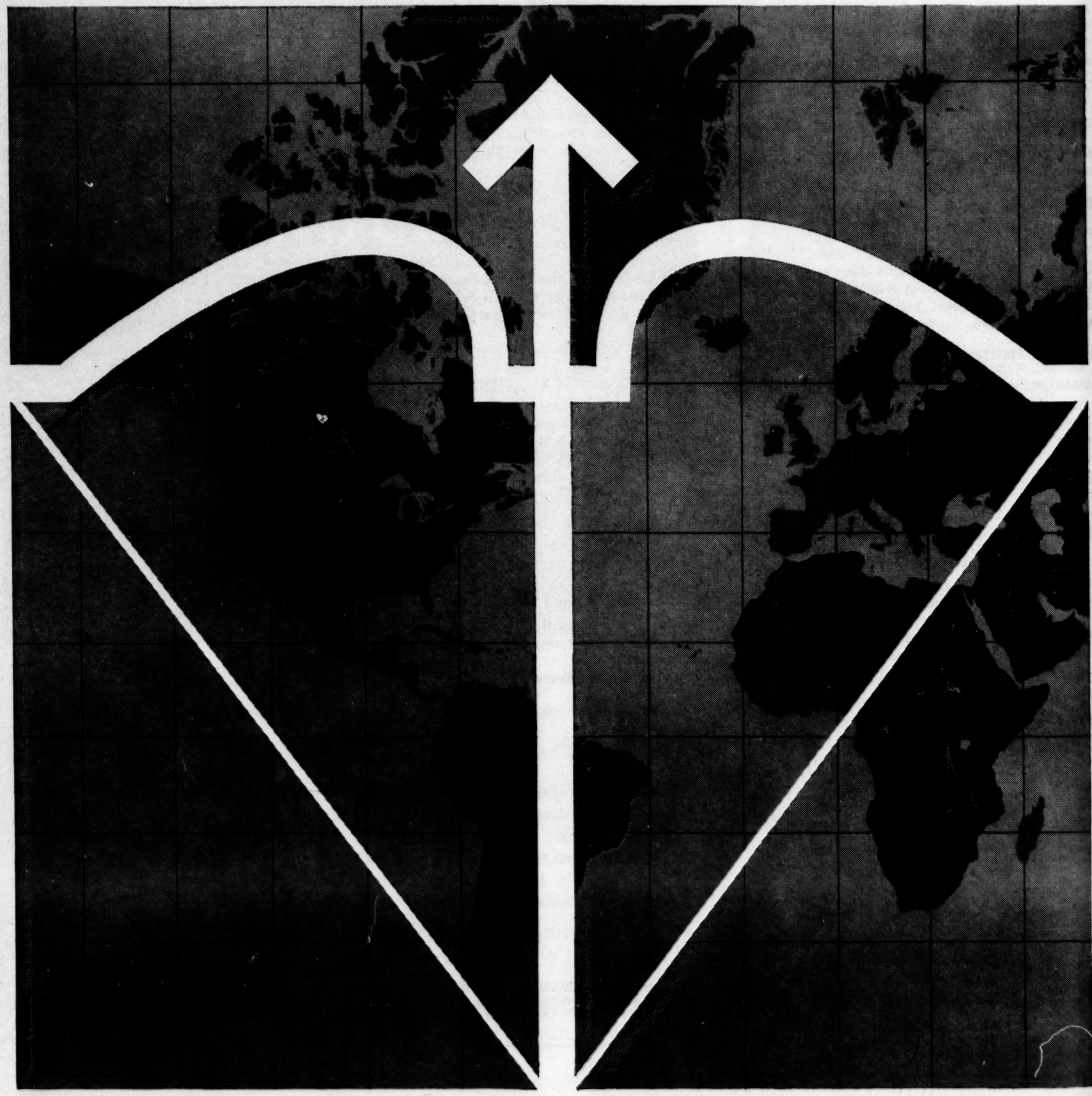


EDITORIAL

Shaping a Modern Strategy

By the end of next week, the first steps should be completed toward shaping a basic new national strategy. The initial step will be the submission of reports to Defense Secretary Robert McNamara by the special task forces he organized in the Pentagon (AW Feb. 6, p. 31). These reports will be followed by discussions at higher levels that should eventually produce a modern national strategy and the initial fiscal and military requirements to implement it. It is heartening to note that the Kennedy Administration has given this task high priority and has applied both speed and talent to its execution.

Even if there had been no change of political administration, such an exercise would have been long overdue. The Fifties were dominated by the national strategy of massive retaliation keyed to high yield nuclear weapons and jet bomber delivery systems. But even when we had such an unquestionable superiority in nuclear delivery capability, we never developed a national strategy that enabled it to be applied decisively to many critical crises, such as Korea and Indo-China. Now the impact of the new technologies offers a far wider spectrum of weapons possibilities, and the expansive energy of the Sino-Soviet bloc has presented a far wider spectrum of their possible application in support of national policy.

United National Policy

In many of the crises of the past decade we apparently have had two foreign policies—one set by the State Department and the other by the Pentagon. It is in this area of forging a unified though flexible national policy that the most obstinate reluctance is likely to be encountered and the heaviest hammer blows will be felt on the administrative anvil. There are hopeful signs, however, that closer and more efficient, continuous liaison between the Pentagon and State Department is emerging as a more effective link in the decision-making machinery of government.

The whole area of costing complete weapon systems through their operational life is an area that needs a fresh and realistic approach. Neither military nor civilian officials in the Pentagon distinguished themselves in the past in handling this admittedly thorny problem of weapon system budgeting in contrast to bookkeeping. Until 1960, the Air Force, for example, had never conducted a single cost study on any of its weapon systems, past, present or future, to determine the complete cost tc the nation from research and development to obsolescence. It is small wonder that the bookkeepers grew frantic when small research and development programs carried along at a few million dollars annually suddenly matured and swelled into billion dollar annual demands for production, deployment and operation.

The budget ceiling approach to this very real problem was neither intelligent nor effective however, and a new philosophy of weapon system costing is urgently needed, not only to get the military books in order but also to give the people of this country, who are paying the bills, a realistic view of the price of their national security.

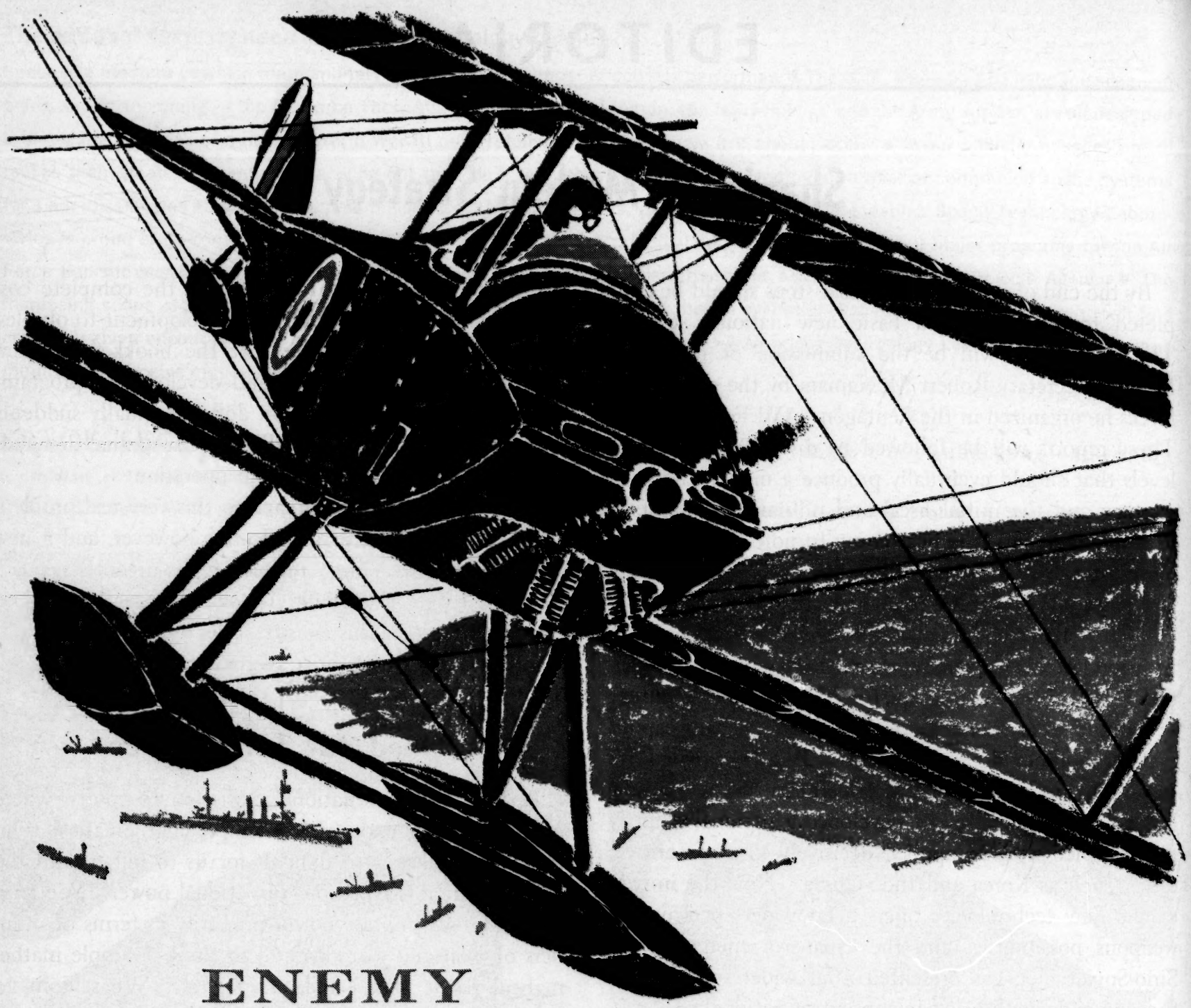
Need for Intelligence

Perhaps it is our national addiction to sports, where each encounter ends with a simple mathematical solution, that makes it so difficult for us to understand the complex variable equations of national power. We tend to equate our military power primarily in terms of numbers of men and weapons and to think a simple mathematical result makes a decision clear. We seldom go beyond these superficial elements of military power into the factors of deployment, operational readiness, tactics and command. Intelligence is regarded as a computer-like operation that can keep an inning-by-inning score of the international arms race, but it is more like the vague sight of an occasional iceberg in the fog that provides some warning of dangers rather than measuring them precisely.

This effort now under way to mold a modern strategy linking the most effective weapons to a realistic and flexible foreign policy is one of the most important activities going on in Washington at the moment. It is bound to step on some traditional toes and pinch some long-held prejudices. No matter how successful it is, there are bound to be squeals and howls of dissent from a variety of quarters.

We earnestly hope that when this exercise is completed, a strenuous effort will be made to make its outlines crystal clear to the American people, for their solid support will be required to make it successful. And upon its success hangs a large measure of the future for us all.

—Robert Hotz



ENEMY LACK OF RECONNAISSANCE "PROTECTS" THE ALLIES AT GALLIPOLI

Gallipoli was a test for reconnaissance.

In 1915 the Allies struck at Gallipoli, intending to pierce the vital Dardenelles passage, capture Constantinople, remove Turkey as an effective fighting force and buoy the flagging spirits of their Russian allies. But the Gallipoli landings ran afoul of entrenched masses of determined Turkish troops. The stalemate continued from April through December, 1915. Finally, the Allied high command decided to evacuate . . . quite a trick when opposing trenches were often only ten feet apart! If the Turkish army should have an inkling of the evacuation before completion—if one effective reconnaissance flight were to examine the Allies' disappearing strength, it would mean disaster . . . perhaps the loss of more than 80,000 Allied troops.

But, while Turkish pre-war planning carefully built a large army, the generals ignored the value of reconnaissance capability, thereby allowing an entire army to escape intact. Allied planes, such as the Sopwith Baby, scanned the skies for Turkish and German recon planes. But none flew out to watch the exodus. For five days troops and supplies were discreetly taken off until only 1500 Allied soldiers manned the lines against the entire Turkish army. And finally everyone had gone. Casualties: 2 wounded.

The spirit and fierce resistance of the Turkish army had been manacled by lack of reconnaissance, a costly oversight.

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Capt. James I. Miller, assistant to the president, Eastern Air Lines, Inc.

Dr. Charles E. Waring, assistant technical director for research and head of the Research Department, U. S. Naval Ordnance Test Station, China Lake, Calif.

Brig. Gen. Theodore C. Bedwell, Jr. has succeeded **Maj. Gen. Otis O. Benson, Jr.** as commander, USAF Aerospace Medical Center (ATC), Brooks AFB, Tex.

Brig. Gen. Frederick C. Weyand, deputy chief of Army Information, succeeding **Brig. Gen. Chester V. Clifton,** who has been named Military Assistant to the President.

Honors and Elections

T. M. Miller, vice president-traffic and sales of Delta Air Lines, has been named a director of Air Cargo, Inc.

Rome P. Clinton of the Aeronautical Division of Minneapolis-Honeywell Regulator Co., has been elected chairman of the Eastern Traffic Committee, Aerospace Industries Assn., and **Carlton P. Roscoe** of Pratt & Whitney Aircraft Division of United Aircraft Corp., was elected vice-chairman. Also: **James A. McSwigan** of General Electric's Flight Propulsion Division was elected chairman of the Rate and Classification Subcommittee.

Changes

Paul L. Styles has been named industrial relations officer, George C. Marshall Space Flight Center, Huntsville, Ala.

(*Continued on page 122*)

INDUSTRY OBSERVER

▶ Project Orion principle of boosting a space platform into orbit by a series of controlled nuclear explosions will be tested, using high explosives rather than atomic bursts, in Southern California. Air Force and its Orion contractor, General Atomic Division of General Dynamics, already have made some tests on a smaller scale, also using high explosives.

▶ **Proposals for a second round of funding for Project Pangloss, a multi-million dollar study of techniques for secure communications between Polaris missile submarines and aircraft, surface ships and other submarines, may be requested soon by Navy. Project Pangloss has been under study for the past year at RCA's David Sarnoff Research Center (AW Aug. 22, p. 23).**

▶ USAF-Martin Titan II replaced Titan I as the booster for the early Dyna-Soar vehicles largely because the glider's weight now is in the vicinity of 12,000 lb., too heavy for the Titan I to boost.

▶ **Possibility of using Navy's Bendix Eagle-Douglas F6D Missileer air superiority weapon system for long-range ground attack and anti submarine warfare missions is under discussion by Navy and the contractors. Eagle guidance for attack missions could be cheaper and less sophisticated, but the ASW application would call for systems not yet developed.**

▶ Watch for a crash program to develop a satellite intercept and inspection vehicle under a different project name than Saint (AW Jan. 2, p. 15).

▶ **Hawker-Siddeley is negotiating for Rolls-Royce RB.163 series turbojet engines to retrofit follow-on models of the Blackburn NA.39 strike fighter. NA.39, now equipped with de Havilland Gyron Jr. turbojets, needs an engine that can provide blowing air for the wing, and the RB.163-11 earmarked for the Vickers VC.11 transport would fit this category.**

▶ Navy is expected to designate a contractor shortly to build Bullpup missiles as a second production source to Martin-Orlando. General Electric, Hughes Aircraft and Raytheon, all experienced in building small air-launched missiles, have been told they are no longer in the running. Chance Vought currently is a leading candidate.

▶ **Aerojet-General's segmented solid rocket engine program involves three phases—recent static firing of a 400,000-lb. thrust unit for 20 sec.; firing a 1 million-lb. thrust engine for 20 sec., and, as an ultimate goal, firing a 1 million-lb. thrust, six-segment engine for 60 sec.**

▶ Advanced logistic system (ALS), which uses computers to control the flow of spare parts to ballistic missile commands, has ordered too many spares for Atlas squadrons. Air Force attributes the substantial surplus to incorrect statistical assumptions used because no actual statistics on failure rates existed early in the program. USAF expects to have ALS working correctly by May.

▶ **USAF-Martin Titan Is will be used beginning this spring to test the AC Spark Plug all-inertial system that will guide the larger Titan II. The test vehicles will be essentially the same missile as the operational prototypes of Lot J, which are now flying, but will be designated Lot M. Titan I ordinarily uses a Bell Telephone Laboratories-Remington Rand radio command-inertial system for guidance.**

▶ Latest production version of the Russian Mi-4 single-engine helicopter has constant-chord, all-metal rotor blades replacing the tapered wood, steel tube and fabric blades on the earlier models. Nose fairing over the ASh-82V engine also has been modified in production to give it a stepped effect.

▶ **New series of USAF rocket sled tests of Minuteman missile components was scheduled to begin last week with studies of guidance components. Test sleds are propelled by North American Rocketdyne Megaboom solid fuel rockets over the 35,000-ft. track at Holloman AFB, N. M.**

SILICOLOGY

Studies in Silicones

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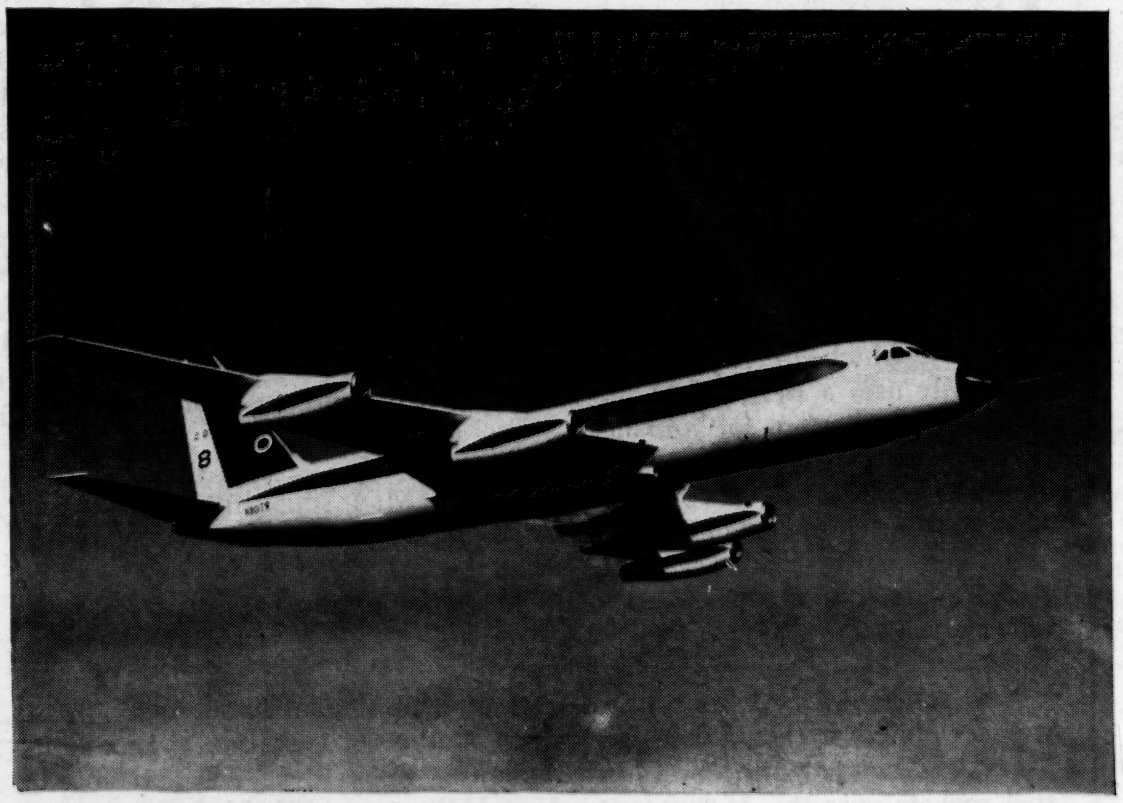

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Washington Roundup

Johnson's Space Reign

Vice President Lyndon Johnson continues to dominate Washington space activities. He is directing selection of the three non-government members for the National Aeronautics and Space Council and selection of permanent council staff members.

Names suggested for the non-government spots so far include Dr. Lloyd V. Berkner, president of the Graduate Research Center in Dallas; former Air Force Secretary Trevor Gardner, and former Army missile chief Maj. Gen. John B. Medaris.

Johnson also put his own man into the National Aeronautics and Space Administration as its public information director, a key position that is one of the top eight jobs in the agency. He is O. B. Lloyd, former newsman who worked for Johnson on Capitol Hill and during the election campaign. Usually, the man for this position is chosen by the NASA administrator rather than an outsider.

Johnson also may upgrade the top staff job on the council, that of executive secretary, to bring it near the same level as the NASA administrator—in importance if not in salary. NASA's chief is paid $22,500 and the executive secretary $20,000 under present law.

Sen. Robert Kerr has dropped his original plan to select two technical men for the top staff jobs on his Senate space committee. He is naming Everard H. Smith, Jr., the committee's counsel since 1959, as chief counsel and abolishing the title of staff director. Smith will handle that function. William Reynolds, formerly an assistant in Kerr's office, has transferred to the space committee staff.

Depressed Area Aid

Steps to facilitate channeling of defense contracts into labor surplus areas will be recommended to Defense Secretary McNamara this week by the secretaries of the three military services. President Kennedy ordered such a program in his economic message to Congress and also recommended expediting of defense work already under way. Thomas Morris, assistant defense secretary for logistics, and Charles Hitch, defense comptroller, are in direct charge of the program.

Deputy Defense Secretary Roswell Gilpatric has assured Rep. Melvin Price, who is the strongest congressional proponent of nuclear-powered flight, that the Kennedy Administration is reviewing former President Eisenhower's proposed elimination of one of the two technical approaches to a nuclear aircraft engine.

Richard Morse, director of Army research and development under the Eisenhower Administration, has been asked to stay for an indefinite period. He hopes to remain in the Pentagon long enough to have the job made an assistant secretaryship, as it is in the other two services, and to see certain projects—including the Nike-Zeus anti-missile missile—through their gestation periods.

Senate confirmed appointment of James E. Webb to head NASA last week. Confirmation of Najeeb Halaby as Federal Aviation Agency chief has suffered a routine delay of about 10 days in forwarding formal nominations from the White House to Capitol Hill.

No Regulatory Czar

Congressional objections apparently have killed any chance that a "czar" will sit in the White House to oversee regulatory agencies such as the Civil Aeronautics Board. James Landis, who has recommended such a post, will remain at the White House for some months completing a study aimed at improving these agencies. But President Kennedy—after some prodding from Congressmen—now questions the wisdom of such a move, chiefly because Congress has what Kennedy calls "special responsibility" for the regulatory bodies.

More airline mergers now seem inevitable, but no firm moves will be made until the Civil Aeronautics Board settles the Southern Transcontinental Route Case and the domestic part of the transpacific case. These are the last of the current major route cases and will determine route structures for all 12 trunklines, which in turn will establish which carriers will be strong enough financially to absorb rapidly expanding seat capacity.

Pentagon has issued a directive blacking out all news from the National Space Surveillance Control Center, including its widely used twice-monthly Satellite Situation Report, which gives orbital information on all U.S. and foreign satellites (see p. 28).

Operations Coordinating Board, which is supposed to see that government agencies carry out decisions of the National Security Council, is being abolished by the Kennedy Administration. Sen. Henry Jackson's National Policy Machinery Subcommittee recommended this last December, saying that the OCB "has little impact."

—Washington Staff

Economic Impact of Arms Control Studied

Senate group asks 440 industry companies for data; number of other Administration efforts under way.

By Katherine Johnsen

Washington—First comprehensive survey of the impact that arms control would have on the economy of the defense industry and the nation is being made by the Senate Foreign Relations Committee. It is based largely on detailed questionnaires sent to 440 firms, including 139 that have appeared in recent years on Defense Department's list of 100 largest contractors.

Findings and recommendations are expected to be presented to the Senate by April. The study was launched by the committee's Disarmament Subcommittee last fall when President Kennedy was still a subcommittee member, and it is now being accelerated in view of his repeated emphasis in public statements on his hope for international control of armaments.

The subcommittee staff now is analyzing replies to the questionnaires, which were sent to the 139 major defense contractors and to 301 other firms, about half of them selected from big business and half from small business.

President Kennedy's seat on the subcommittee has been filled this year by Sen. Stuart Symington (D.-Mo.). Other members are Sen. Hubert Humphrey (D.-Minn.), chairman; Sen. Albert Gore (D.-Tenn.), Sen. Frank Church (D.-Idaho), Sen. Bourke Hickenlooper (R.-Iowa) and Sen. George Aiken (R.-Vt.).

Sen. Humphrey said it is his conviction "that our economy will continue to expand regardless of the nature of any defense cutbacks, but I am also sure that we must study the areas which might be immediately affected by arms limitation measures."

In addition to detailed information on military orders, backlogs, payroll and employment, the questionnaire requests contractors' confidential opinions on these questions:

- **What would be the effect** of a total cut-off of defense work on your company—immediate, a short-term or a long-term adverse effect, a short or long-term beneficial effect?
- **How has defense work** affected your non-defense production—reduced, postponed, facilitated the production of non-defense by-products?
- **How would your company** adjust to loss of defense contracts—by obtaining more government non-defense contracts, producing new products, expanding into foreign markets, obtaining contracts for installation of control, monitoring, and inspection equipment and facilities for use in arms control agreements, by reducing production to the extent of defense work lost?
- **Should the primary** responsibility for industry adjustment rest with industry or the federal government?
- **Recommend steps** that should be taken by the federal government: tax reduction or adjustment, increased non-defense expenditures, depressed area aid, expansion of aid to underdeveloped countries, expansion of unemployment compensation, easing credit conditions?

Budget Bureau Study

A Budget Bureau study projecting federal expenditures for the next ten years estimated that under a "safeguarded" disarmament program, national security expenditures would be reduced from $45.6 billion in Fiscal 1960 to $22.4 billion in Fiscal 1970. The reduction would be slow at the outset, reaching $44.7 billion by Fiscal 1965, according to the study.

Prepared under former Budget Director Maurice Stans, the study was submitted to the White House on Jan. 18, two days before the inauguration of President Kennedy.

The study concludes that arms reduction would not necessarily mean a reduction in the size of the total federal budget, for these two reasons:

- **First, increases** in expenditures for non-military international programs would likely follow from arms control. These would be necessitated by considerations of stability in underdeveloped nations and the prospect of increased competition from the Communist bloc in non-military areas, as well as by humanitarian objectives of assisting the impoverished. The study estimated that while expenditures for military assistance would decline from $1.6 billion in Fiscal 1960 to $600 million in Fiscal 1970 under an arms control program, the total U. S. expenditures on non-military international programs would rise from $1.8 billion in Fiscal 1960 to $4.1 billion in Fiscal 1970.
- **Second, the pressures** for expansion of public works and other domestic non-defense programs would radically increase under an arms control agreement. The study commented that "there are already enough programs being seriously considered . . . so that by 1970 the possible increase in non-defense expenditures could absorb three-quarters of the savings in defense spending." An actual increase in the total federal budget under arms control was projected for Fiscal 1965: $94.7 billion with arms control, compared with $88.8 billion without arms control. As the pace of military cutbacks increased over the following five years, the study estimated a total federal budget of $92 billion with disarmament, compared with $97.4 billion without disarmament.

The executive branch organization for handling disarmament is still in an embryonic stage, and it is expanding slowly while awaiting the recommendations of John J. McCloy, the President's disarmament adviser, particularly on the question of whether an independent agency should be established.

Changing Situation

McCloy initially was named by Kennedy to head the State Department's U. S. Disarmament Administration, created late in Eisenhower's final term in office.

Because the situation is changing swiftly, McCloy now is referred to simply as adviser to the President on disarmament.

Last week, McCloy named Adrian Fisher, 47, his deputy. Fisher was a wartime Air Force navigator, and also served as assistant executive officer to the assistant secretary of war. In 1948-1949 he was general counsel of the Atomic Energy Commission, and from 1949 to 1952 he was legal adviser to the State Department. Since 1955, he has been vice president and counsel for the Washington Post Co.

More NATO F-104Gs

Los Angeles—Defense Department will order an additional 400 Lockheed F-104G fighters to re-equip European air forces under the Mutual Defense Assistance Program. Initial increment of 33 aircraft will be funded with Fiscal 1961 money, and the North Atlantic Treaty Organization nations most likely to get the supersonic fighters to replace obsolescent present aircraft are Denmark, Norway, Greece and Turkey. The additional F-104Gs will be built by Lockheed's California Division, and production probably will run into 1964.

Secretary of State Dean Rusk chose Arthur Dean last week as principal U. S. negotiator for nuclear test ban talks. Dean, who will work closely with the McCloy group, served as chairman of the U. S. delegation to the 1958 United Nations conference on the law of the sea, and he was a leading negotiator in the discussions which led to the Korean War armistice.

The Disarmament Administration now has a staff of approximately 50, primarily representatives from State, Atomic Energy Commission, Defense Department and the U. S. Information Agency, and it will expand as quickly as possible to a planned staff of 100, including representation from Central Intelligence Agency. The administration is now headed by an acting deputy administrator, Edmond Gillion, a career foreign service officer, has a Fiscal 1961 budget of $400,000, and is now negotiating with the Institute of Defense Analysis for arms control studies.

The two key administrators and coordinators at Defense are: Addison Lanier, an attorney in international relations, who heads the disarmament staff in the office of Paul Nitze, assistant secretary of defense for international security affairs; and Rear Adm. Paul Dudley, who is in charge of the disarmament staff of the Joint Chiefs of Staff.

In addition to State and Defense, at least three other government agencies have undertaken general arms control studies: National Security Council, Central Intelligence Agency, and U. S. Information Agency.

A complete list of all the programs under way in the executive branch, including programs being performed under government contract, has been furnished the Disarmament Subcommittee on a confidential basis. Sen. Humphrey's attempts over the past three months to have the report partially declassified for public release have been unsuccessful.

Nitze and Jerome B. Wiesner, the President's science adviser, have been qualifiedly optimistic on the prospects for an international arms control agreement.

A report drawn by Nitze, James E. King, associate director of research for IDA, and Arnold Wolfers, director of the Washington Center of Foreign Policy Research of Johns Hopkins University, is being used as a basic document by the Senate Foreign Relations Committee in its consideration of disarmament, and it was the subject of a discussion session of the full committee last week.

The report discredits "total disarmament," but takes the position that self-interest on the part of both the U. S. and the Soviet Union, as well as other nations, make an arms control agreement feasible and possible. The key to the agreement would be the maintenance of a retaliatory force—sufficiently strong to deter—by each of the two powers. It discounts the possibility of "foolproof" inspection—which has been widely called for in the Congress—and puts emphasis on "acceptable risks."

Under a program approaching total disarmament, the report notes, "even a small number of secreted or clandestinely manufactured nuclear weapons could disrupt the international order and allow one power to dominate its more trusting adversaries."

In support of controlled armaments, the report states:

"Let us assume that such an arms control system permitted each side to maintain 200 or 300 strategic nuclear weapons so hardened, mobile and dispersed that to eliminate any one of them would require a substantial number of attacking weapons of great destructive power and accuracy. Under such conditions, even the surreptitious addition of several hundred weapons to the attack capability of one side or the other would not be sufficient to upset the stability of the system. Any temptation to violate the system would be restrained by the knowledge that a very great effort, indeed an effort so great as to run the high risk of detection, would be required before the inherent stability of the system could be overcome."

The report favored maximum production of Air Force's Minuteman and Navy's Polaris missiles. It said the control plan should be accompanied by commitments to "openness of scientific and technological research. Such a commitment may not be enforcible in detail. Violation, however, to be effective would probably have to be on a scale lending itself to detection."

Wiesner's position reflected in recent writings, is similar in outlook to the Nitze-King-Wolfers report. "The objective should be to find security systems less dangerous than the accelerating arms race rather than to achieve a system capable of providing absolute security, an obviously unobtainable goal," he said. "If this point of view were accepted by both sides, many different comprehensive arms-limitation systems capable of providing adequate security to all participants could be designed, and in all likelihood one of these would be completely acceptable."

Bell Claims Eight Helicopter Records

Hurst, Tex.—Eight world distance and speed records for light rotary-wing aircraft were claimed last week by Bell Helicopter Corp. Two of the records will beat current USSR and Czechoslovakian marks if confirmed by Federation Aeronautique Internationale.

The Bell records were made by two company test pilots flying Model 47G Trooper and 47J-2 Ranger helicopters and bring to 16 the number of world helicopter records claimed by the company.

This is more than the total held by any foreign nation and more than the total held by all other U. S. rotary-wing manufacturers combined.

Bell test pilot Al Averill, flying a Model 47G, laid claim Feb. 8 to three records in a nonstop solo straight-line 729-mi. flight from El Paso to Texarkana, Tex., for rotary-wing aircraft with a gross takeoff weight between 1,102.3 and 2,204.6 lb. His average speed of 102.392 mph. will be submitted as a record claim for speed between two predetermined points in two classes, one for the same weight class as his distance claim and the other for the open class (all weights) for rotary-wing aircraft. There are no recognized records in any of these classifications.

Bell test pilot Lou Hartwig, flying the same helicopter, claimed three records on a single flight Feb. 2. On a closed-circuit course of slightly more than 100 km., from near the Bell plant at Hurst, Tex., to Cleburne, Tex., Hartwig made 10 round trips covering 631.436 mi. for a distance record claim, averaging 73.985 mph. for 500 km. (310.7 mi.) and 73.641 mph. for 1,000 km. (621.4 mi.), which are also claimed as speed records over those distances, in the weight class of 1,102.3 lb. to 2,204.6 lb. There also are no recognized previous records in these classes. During his 10-lap circuit, Hartwig flew non-stop solo for 8 hr. 26 min., the Model 47G being fitted with extra fuel tankage providing a total of 96-gal. capacity.

On Jan. 31, Averill and Hartwig, flying solo in a Model 47J-2 Ranger, made runs over the Hurst-Cleburne course to set new records for speed over 100 km. Averill achieved 107.082 mph. for a weight class of 2,204.6 lb. to 3,858 lb. to break a record held by the USSR which was set May 29, 1958, when a Ka-15 flew the course at 101.149 mph. Two hours later, with the airplane lightened through reduction of fuel, and with the lighter-weight Hartwig aboard, the same 47J-2 flew the 100-km. course at 104.613 mph., exceeding by almost 50% the mark of 70.36 mph. set by a Czech HC-2 Helibaby on June 27, 1959, for helicopters in the weight class 1,102.3 lb. to 2,204.6 lb., for that distance and weight.

Record claims have been submitted to FAI for homologation. Bell engineer Richard S. Stansbury was company coordinator on the record attempts and Tom Triplett was National Aeronautic Assn. officiating director.

Soviets Launch Seven-Ton Sputnik, Maintain Silence on Its Purpose

Washington – Soviet Russia's latest and heaviest Sputnik was transmitting weak video signals in a decaying orbit late last week as a near-complete Soviet silence caused widespread speculation as to the satellite's purpose.

Weighing 14,292 lb., Sputnik VII was launched Feb. 4 by what Russia described as an improved multi-stage rocket. One scientist, active in the U.S. space program, said this could indicate the first Soviet use of liquid hydrogen-liquid oxygen upper stages–propellant combination the U.S. will use in Centaur and Saturn upper stages.

Sputnik VII was transmitting television signals on a frequency of 66.2 mc. and telemetry on 66 mc. Video transmission is on the dividing line between Channels 2 and 3 on U.S. receivers. Telemetry signal was described by U.S. tracking units as clear.

Satellite was expected to be short-lived because of its low orbit. Four days after launch, perigee had dropped to 110 mi. from 139 mi., apogee rose to 238 mi. from 203.5 mi. and the period had decreased 0.1 min. to 89.8 min. Re-entry was expected when the period reached 87.5 min.

The U.S. knew of the Feb. 4 launching before the satellite had completed its first orbit, but rejected an opportunity to remove some of the propaganda edge and waited until Moscow announced the shot–then simply confirmed it.

The U.S. had enough information to announce launch and orbital data in time for an early Feb. 4 news bulletin because of the time differential. Instead, the first reports in this country were printed late that day, following U.S. confirmation.

Decision to allow the opportunity to make the first announcements pass apparently reflects an Administration attitude of muting discussions of intelligence and the means the U.S. uses to gather this data. There had been no previous attempt to disguise the purposes of the civilian, military space surveillance networks (AW Jan. 30, p. 33).

Three weeks before Sputnik VII was launched, the Pentagon announced it had tracked what apparently was a Soviet missile, with its ballistic missile early warning station at Shemya, Alaska.

The Sputnik VII booster sent three objects into orbit. In the lead was the spent final-stage casing, which was expected to re-enter first. Trailing by 10 min. was the payload shroud, and the scientific package followed the shroud by 11 min.

Gross liftoff weight of the launch vehicle and its payload is estimated to have been between 400,000 and 700,000 lb., the lower figure based on use of liquid hydrogen and oxygen, and the higher weight based on use of kerosene and oxygen. Static thrust for the clustered booster stage could have been as high as 800,000 to 1 million lb.

Moscow comment on the latest Soviet space venture centered around the great payload weight made possible by use of an improved rocket. The Soviets have reported foreign reaction and praised the complexities of the scientific experiments. The only specific details carried by the Soviet radio and press late last week were on the initial orbital elements and payload weight.

Probably closest to an official explanation of the scientific objectives of Sputnik VII was given by Y. L. Krinov, who categorized the satellite as an instrument to measure and study the atmosphere and meteorite matter. Krinov is president of the International Committee on Meteorites of the World Geological Congress.

Speculation on the payload has come both from Soviet bloc sources and from outside the Communist area. It ranges from opinions that Sputnik VII is a reconnaissance satellite to theories that it contains one or more pilots. Representative reports have come from:

- **Britain:** It is probably a spy satellite similar to the U.S. Samos. Reasoning is based on lack of official Soviet statement of transmission frequencies.
- **Italy:** Satellite may contain a man, based on recordings made by two radio amateurs and substantiated by a phonocardiogram of "moans, heartbeats and heavy breathing."
- **Germany:** Bochum Observatory reported picking up fragments of Russian words and Morse Code.
- **Hungary:** Satellite contains "various clever and complicated apparatus for the study of the earth's upper atmosphere" to be used to plan trajectories for manned flights.
- **Rumania:** Satellite is valuable for scientific studies and solution of construction problems.
- **Czechoslovakia:** Heavy Sputnik was a test vehicle for fast acquisition of information, and to test a landing mechanism.

It is unlikely that the satellite contains a pilot in view of two recent Soviet comments which reflect a growing concern for pilot safety, a concern also expressed last week by President Kennedy (see p. 29).

On Jan. 26, Y. K. Federov, principal scientific secretary of the USSR Academy of Sciences, told the diplomatic corps in Moscow that although Soviet biological research has provided confidence on the possibility of manned space flight, "much time [is] still needed to ensure complete safety for man in flight, especially during his return to earth."

In the second recent reference to caution in manned space flight, the Soviet publication Moskovsky Komsomolets said last week that USSR "has already got all that is necessary to put man into space. But the nature of space flight is so serious it precludes any approach which treats it as a sport, chance or an occasion for publicity."

Krinov said Russia puts its space vehicle launches into three broad categories: artificial earth satellites, of which four have been launched; space rockets (which the U.S. calls probes), with three launched, and spacecraft-laboratories, three launched.

Chronological space vehicle weight growth shows the potential of the Soviet boosters to carry sizable, multi-man laboratories into orbit, but there are admitted problems in recovery techniques. Only one of three recovery attempts of spacecraft-laboratories has been successful–Sputnik V, or Spacecraft II, was recovered after 18 orbits on Aug. 20.

Two-Man Spaceship

Washington–Possibility that Sputnik VII is the first test model of a two-man spaceship was raised late last week by scientists and commentators from Communist bloc countries, although Russia itself had not confirmed this.

A Soviet microbiologist said that its size could accommodate both small animals and a human being. An East German commentator called the sputnik a spaceship and said it provides space and living conditions for two human beings.

Soviet Opposition

Moscow–Soviet Union is taking a dim view of proposals for joint European space exploration programs, discussed recently in Strasbourg, France, by members of 12 nations (AW Feb. 6, p. 35).

Despite frequent Soviet emphasis on the peaceful purposes of the Russian space effort, Pravda has noted that "it is clear even to children that a satellite can be orbited only by means of a powerful ballistic rocket, which is of great military importance."

Pravda also asked: "Is participation of Austria, Sweden and Switzerland in implementation of a program for providing NATO with ballistic rockets compatible with their neutrality?"

Mercury Chimp Test Might Be Repeated

By Edward H. Kolcum

Washington—Decision will be made soon whether the Mercury-Redstone mission should be repeated with a chimpanzee before a man is launched on a ballistic flight, but it probably will not be announced until shortly before the MR-3 launch.

President Kennedy implied last week that pilot safety is the overriding factor in manned space flight, and it is likely that his views will heavily influence the decision whether a human or primate passenger will ride MR-3.

Technical Assessment

Detailed assessment of MR-2 flight data is being made and will be the basis for the technical decision on the next Redstone-boosted capsule flight. The MR-2 mission was marred by unusually high velocity Redstone performance, and the unexpectedly high stresses produced have led to a reassessment of the MR-3 mission.

The Redstone's excess velocity was caused by a jammed thrust regulator, a system which previously had a history of exceptional reliability. As on previous development flights of production hardware, the Mercury capsule and its systems performed precisely as expected (AW Feb. 6, p. 26).

President Kennedy made it clear at his news conference last week that he will be satisfied if the U. S. is second to Russia in launching the first manned space flight as long as the U. S. pilot has high chances of survival.

"We are very concerned," he said, "that we do not put a man in space in order to gain some additional prestige, and have a man take a disproportionate risk . . ."

Examination of data indicates the chimpanzee passenger in MR-2 underwent more severe flight loads than were originally estimated. The chimp was subjected to re-entry deceleration of about 16g and to 6.6 min. of weightless flight. When the escape rocket fired, the animal underwent a 17g force for about one second. The 7g launch acceleration and 16.5 min. total flight time are close to original estimates.

Immediately after the shot, it was estimated that re-entry forces were 12g, about 1g more than planned. The chimpanzee was subjected to loads in excess of 10g for about five seconds of the 1.5 min. re-entry phase.

Chances are small that a high velocity launch would increase engine chamber pressure to the point where the booster would explode in either Redstone or Atlas missions, according to Warren J. North, NASA manned satellite programs chief.

He said chances also are slim that a dangerous situation would develop if the Atlas thrust regulator jammed the way the MR-2 regulator did. Most serious result of a "hot" Atlas booster operation probably would be insertion of the satellite into a slightly eliptical orbit, allowing less than desired precision in selecting the recovery location.

Vehicle Velocity

For this to happen, the Atlas thrust programer and the backup thrust terminator, operated on radio command from the ground, both would have to malfunction. Vehicle velocity is read out at the ground control center. Any abnormal velocity increase can be detected immediately, and the sustainer engine would be shut down.

If both primary and backup modes should fail, however, the retrograde rockets would be ignited near apogee and re-entry phase would begin near perigee. The capsule would be over the U. S. at perigee on the first three passes.

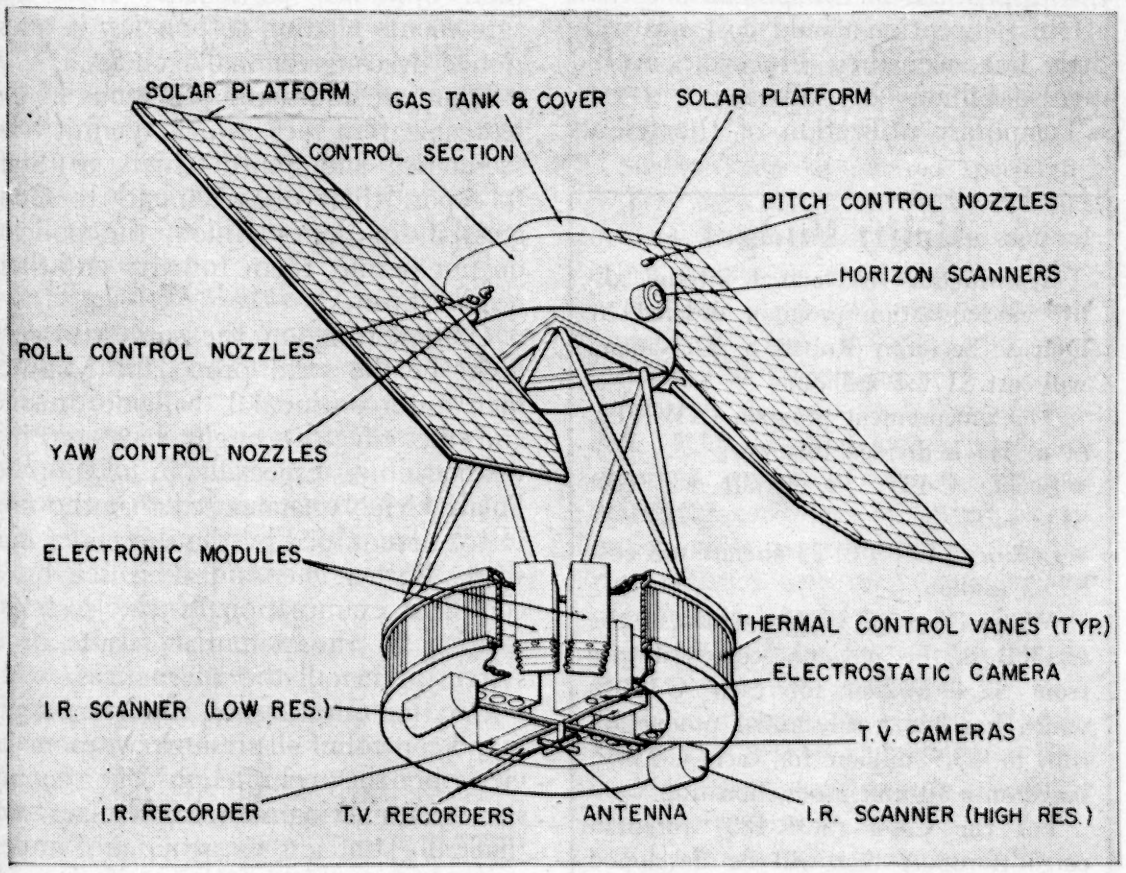
Abnormally long flight of the MR-2 was caused by the thrust regulator, which set off a chain of events for the capsule system. With its "open throttle" operation, the booster fuel was depleted about 5 sec. before scheduled burnout. Combustion chamber pressure went down to signal thrust decay, and the escape rocket automatically ignited to start the high altitude abort maneuver.

The retrorocket package was jettisoned when the escape rocket ignited, which prevented use of these rockets to act as brakes. Ignition of the retrorockets would have cut the range of MR-2 from 420 mi. to about 370 mi., which is about 60 mi. greater than the planned range.

Escape Tower Jettisoned

In MR flights, the escape tower remains part of the system until the booster shuts down. When Atlas is used as a capsule booster, the escape tower is jettisoned at staging, when the booster engines drop off and the sustainer is still burning.

Beryllium heat shield in the MR-2 capsule apparently was torn loose by sea action just a few minutes before the capsule was retrieved by a Marine HUS helicopter from the USS Donner. The shield is suspended on the lower end of a four-foot rubberized glass fiber



Nimbus Scheduled to Be Orbited Next Year

Polar orbiting Nimbus weather satellite will be built by General Electric Missile and Space Vehicle Department under a $4.5-million contract. General Electric also will integrate the satellite systems, which will include six television cameras, solar converters, recorders and command equipment. This second-generation weather satellite will weigh about 650 lb. and is scheduled for launch next year on a Thor Agena B vehicle. Primary data acquisition site will be in Fairbanks, Alaska. General Electric has the contract for the Nimbus control and stabilization system. Other system contracts are held by Radio Corp. of America, cameras and solar conversion; International Telephone and Telegraph Laboratories, infrared; Radiation, Inc., telemetry system, and California Computer Products, command system.

air cushion which is released after the main parachute is deployed. This operation is the same as that programed for Atlas flight capsules, which will use ablative shields.

Because the Mercury capsule overshot its target area 120 mi., it took U. S. Navy and Marine Corps recovery forces 178 min. to retrieve it from the water. During this period of recovery, the shield bumped into the pressure bulkhead and drove several small bolt-heads into the structure.

The reinforcing steel straps used to support the shield probably became fatigued and allowed it to sink, and the skirt was torn by the sharp edges of the straps.

Impact skirt and shield are designed to act as a sea anchor to stabilize the floating capsule, as well as to attenuate landing shock. When the shield fell free, the capsule tipped on its side and sea water entered the structure through valves on the neck. The valves are used to equalize pressure during re-entry.

Water in the capsule could also have leaked in through the pressure bulkhead where it was struck by the shield, but the amount of water was not considered dangerous.

Little Administration Support Seen For Early Major Defense Shifts

By Larry Booda

Washington—None of the immediate major shifts in defense strategy hoped for by some military partisans appeared to have Administration support last week following a brief revival of the "missile gap" argument.

The argument arose when a number of newspapers printed stories indicating that the Kennedy Administration had found, through Defense Department studies, that no "missile gap" existed between the U. S. and Russia, that former President Eisenhower's estimate of Russian missile capability was essentially correct, but that increases in some programs would be necessary.

The stories grew out of what Secretary of Defense Robert S. McNamara had intended to be an off-the-record briefing for use as background by a group of Pentagon reporters. Republicans in Congress immediately seized the opportunity to demand that an apology be made to Mr. Eisenhower for criticism of his defense program made by Democrats during the election campaign. The Republicans also accused President Kennedy and McNamara of closing the "missile gap" after just 18 days in office.

One story also said the U. S. had given up the idea that it should never strike the first blow in a nuclear war. The President, through his press secretary, denied, the day after the McNamara briefing, that the Pentagon had found no "missile gap" and denied that the U. S. would consider engaging in pre-emptive or preventive war.

At his press conference the next day, President Kennedy refused to be drawn into a discussion of McNamara's reported remarks. But he said that current studies by four panels in the Defense Department in the areas of strategic weapon systems, limited war capability, bases and research and development (AW Feb. 6, p. 31) are not complete and therefore it would be premature to reach a judgment as to whether there is or is not a gap.

The Defense studies, initiated on a crash basis, are expected to be completed about Feb. 20. Their conclusions and recommendations will be forwarded via McNamara to the President shortly thereafter. Actions of the four panels to date have indicated:

• **A strong desire to avoid** overspending through initiation of programs which at their inception would cost relatively little but over their life cycles would involve billions of dollars.

• **Temporary utilization** of the talents of a group of civilian specialists in defense planning from the Rand Corp., Defense and service planning groups and universities.

• **A tendency to consider** military officers as being available only to furnish facts and figures to support previously conceived policies. Military members have been working seven days a week.

Prior to the President's press conference, Secretary McNamara had announced elimination of two secretaryships, accelerated programs in airlift procurement and Polaris submarines, and the panel studies.

He also stated this management philosophy:

• **During the development** of policies relating to the Defense Department, he expects full and open discussion within the department by all leaders, military and civilian, without regard to whether their views conform to those of others, including his own.

• **Once a decision** has been reached and a policy established representing a decision of the President or other appropriate authorities, all members of the department, military and civilian, will be expected to support that decision, publicly or otherwise.

• **When he says they** are expected to support policy publicly, he does not mean that officials should not express their opinions, particularly their disagreements relating to policies, if questioned by congressional agencies.

• **There are additional provisions** in the reorganization act which permit the secretaries and Joint Chiefs of Staff to report their disagreements to Congress if, in their opinion, the policies do not permit them to carry out their responsibilities.

Commenting on the successful first flight of the solid propellant Minuteman intercontinental ballistic missile and the effect it might have on the weapons mix, especially in relation to Polaris, McNamara stated that the mix is not determined by the success of one shot. Rather, he said it is set by a complete examination of the costs in relation to the potential results of a system versus all the alternatives.

On the question of changing command control of all strategic weapons in view of the completion of a joint strategic targeting plan, McNamara said that all strategic weapons are under command control of the unified commands, the Joint Chiefs of Staff, himself and the President. The establishment of a targeting center should have no effect on command control, he said.

McNamara said that the money that would have been saved by bringing military dependents back—$80 million in 1961 and $200 million a year after that—now will be saved by controlling overseas expenditures by these personnel.

Airlift Budget

Washington—Accelerated interim airlift modernization program ordered by Defense Secretary Robert S. McNamara will cost $172.2 million.

The procurement program (AW Feb. 6, p. 31) is divided this way:

• Boeing C-135: 30 aircraft will cost $117 million.

• Lockheed C-130B: 23 aircraft will cost $55.2 million.

When the C-130E replaces the C-130B in the program, costs will rise from $2.4 million for each C-130B, which has had a substantial production run, to $3.5 million for each C-130E, based on a 50 unit production run.

For the CX-1 (SOR-182) turbofan cargo transport that will be developed under the SS-467L program, Defense Department has $30 million available in the current budget and is allotting $98 million in the Fiscal 1962 budget. Total program calls for 132 aircraft.

Defense plans to add $30 million to the $192 million already allotted for airlift modernization in the Fiscal 1962 budget for 15 C-130Bs, 27 assault C-130Bs and the CX-1.

Soviets Review Science Problems, Gains

Moscow—One major problem remaining to Soviet science, despite its unprecedented programs in space, automation and other fields, is learning how to translate scientific findings into production line technology more quickly, speakers told the recent annual meeting of the USSR Academy of Sciences.

Academy President A. N. Nesmeyanov said science academies now exist in all the republics of Russia. Next they must function successfully and go ahead with the establishment of more big scientific "cities" such as the one under construction at Novosibirsk, he said. Speakers outlined these major Soviet scientific problems:

• **Cooperation between science** and industry still is unsatisfactory, despite major efforts and some progress. In practice, the annual plan, enumerating research achievements that are recommended for application to industry, has been composed chiefly of items of "secondary importance." Best contributions have been made outside the plan, reflecting poor planning and organization.

• **Although much good equipment,** such as computers and accelerators, is available, the "supply of equipment to institutes still lags far behind the demands made of experimentation today."

• **"We must train more** and better scientific manpower to make new progress. In the next 10 to 20 years, we must multiply the army of scientists." A number of recent articles in the Soviet press also have called for better training of scientists.

• **Interrelations between branches** of science now are so important that scientists must combat the attitude that "my brother is my enemy," which sometimes exists now between mathemended for application to industry, has maticians, economists, geologists, chemists, etc. Cooperation is much better among the disciplines of physics, biology and chemistry.

Research areas that must be emphasized, Nesmeyanov said, include space, thermonuclear power, artificial photosynthesis, synthetic foodstuffs, direct conversion of energy from chemical reactions into mechanical motions and research into the depths of the earth. Academician Y. K. Federov said many of Russia's outstanding physicists are reactions. Among the accomplishments cited by Nesmeyanov and others were:

• **Important discoveries** in synthesis of new polymers and monomers. Work has reached the practical application stage on polypropylene, polyformaldehyde pentanes and carboxylate rubber as well as on polymers with electrical properties, increased heat resistance, etc. Polyisoprene, with high molecular weight and structure similar to India rubber, has been derived for the first time.

• **Methods for synthesizing** diverse organometallic and organoelemental compounds have been evolved and many new types of substances derived.

• **Laboratory unit** for zonal refining of refractory metals with the help of an electron beam has been designed, and for the first time, monocrystals of pure refractory rare metals—molybdenum, tantalum and rhenium—have been obtained.

• **Chemical work** on a new method for compressing powders with the help of low frequency vibration.

"Of considerable interest are newly developed, highly efficient installations for obtaining liquid helium and for separation and liquefaction of air," Federov said. "Trials of an operating model have shown results most interesting for development of large capacity installations."

Space radio research has revealed blobs of coronal plasma near the sun which move at about right angles to the radial plane at a speed of approximately 620 mps., Federov said. At such speeds, the blobs should follow open orbits, but at lower speeds these clouds of plasma may become natural satellites of the sun, he said.

Major investigations have been conducted recently into the motion of bodies at high speeds, Federov said. "Results achieved will make for further progress in aircraft construction," he said. He gave no further details, but the Soviet news agency Tass carried a story that an aerodynamics group headed by Academician G. Cherny had been recommended for the Lenin Prize for work on movement of bodies at high speeds.

This group claimed that movement of a body in air at great speeds can be regarded as a continuous series of explosions from charges distributed in places through which the body flies.

This prompted Cherny to link the theory of air movement during powerful atomic blasts and aerodynamics of great supersonic speeds. In the Tass article, Academician Leonid I. Sedov, president of the International Astronautical Federation and head of Russia's space research group, commented that the Cherny theory "permits us to calculate in simple for pressure in different points of a flying vehicle's surface, to determine drag, to calculate air movement at high temperature."

Nesmeyanov said "exceedingly important results have been obtained in elaborating theoretical and practical problems of automation, but he gave few details. Broad use of computers in science and industry is bringing "mathematization of science," he said.

Federov said "considerable success" has been achieved in the development of automatic control. "We mean successful elaboration of theory of optimal control of objectives with spreading parameters which are of great importance for continuous production processes in the iron and steel industry, chemical production and oil drilling. A series of pneumatic general purpose components with small over-all dimensions which can be used to assemble different automatic control systems already has been put into production."

Federov chastised Soviet economists for their inability so far to make scientifically substantiated recommendations for the solution of such problems as price formation, application of mathematical methods to national economic planning, and making technical economic estimates for introduction of new technology into the economy.

Soviet Cell Research

Moscow—Processes of cellular division in plants and animals are accelerated under spaceflight conditions, Soviet Academician Norair Sisakyan has told the USSR Academy of Sciences biology department.

Sisakyan said he referred specifically to peas, corn and wheat seeds, and said definite modifications also were noticed in cell division of marrow of mice. Orbital flights of at least two of Russia's "spaceships" have included mice and specimens of these plants.

Sisakyan also said the effect of magnetic fields on germinating seeds increases if oxygen is reduced. He said that flight conditions in spaceships operating on a circular orbit below the great radiation belts cause no major disturbances of physiological functions of organisms, but emphasized that the organisms are not indifferent to such flight. Successful application of telemetry and television techniques have made possible comparisons in spaceflight and in earth tests, he said.

Fragmentary press accounts of the recent closed annual meeting of the academy also quoted Sisakyan as saying that the discovery of magnetotropism in plants was one of the most original pieces of research done last year by Soviet biologists.

Magnetotropism means that plants whose roots face the south magnetic pole develop more rapidly than those whose roots face in the opposite direction.

Douglas Urges National Aviation Policy

New York—Trend toward mergers in the U. S. aerospace and airline industries may necessitate the need for a new national aviation policy, implemented by new legislation or interpretations of the anti-trust laws, Donald W. Douglas, Jr., president of Douglas Aircraft, told the New York Society of Security Analysts.

Douglas cited development of a supersonic transport, in which costs are far beyond financial capabilities of a single company and the end product may cost up to $25 million per airplane. He added:

"Thus we see the government, through the Federal Aviation Agency, displaying interest in a program to develop such an aircraft by pooling the technical and financial resources of several companies, and providing some financial support with public money as well."

Douglas contended that future strength of the industry "may require closer cooperation or outright mergers," noting the recent consolidation in the United Kingdom of the aerospace industry into a few principal groups.

Supporting Legislation

In this vein, Douglas called for consideration of:

- **Supporting legislation** such as that given the maritime industry in the Merchant Marine Act of 1936. For example, the government might share costs of developing an adequate air cargo system which would have value in case of a national emergency.
- **New tax policies** that would "encourage such basic and applied research by private industry as would be in the national interest." New depreciation policies might be developed for "an industry where a dynamic technology imposes facility obsolescence problems of unique severity."
- **Careful attention** to development of international economic policies as they apply to aviation. Douglas claimed that the "serious gold flow problem" tempts some to "Buy American—Fly American," an approach he termed "shortsighted" and one which, in an attempt to deprive other friendly nations of a fair share of traffic, would be to "abdicate our leadership in international aviation."

Turning to Douglas' present posture, the chief executive noted that despite net sales in 1960 of $1,174,041,175 (up $340,156,947 from 1959), the company registered a net loss of $19,429,437. But Douglas added that this was a "substantial improvement" over 1959 when the loss was $33,822,229.

Sales increase largely was due to delivery of 91 Douglas DC-8 jet transports and related spare parts; however, military and other government sales slumped to $626 million from the $779 million achieved in 1959. Decline in this area was mostly due to phase-out of the Thor intermediate range ballistic missile and cutback in the Army Nike Hercules program.

The year's loss of $19 million, equal to $5.09 per share, resulted, Douglas continued, from development costs and production losses on the DC-8 program, combined with the decision to write off anticipated DC-8 development and inventory costs at the end of the Fiscal 1960 third quarter. Company wrote off $292 million on this program.

But, on an over-all basis, fourth quarter operations resulted in a net profit of $2.4 million, or $.64 per share.

In the commercial area, where Douglas attained $548 million in sales last year, Douglas commented: "In all candor, orders for the DC-8 and for the Caravelle, for which we have sales rights, did not live up to expectations in 1960."

Because of the relatively few new orders for the DC-8, Douglas' commercial backlog at year-end totaled $238 million, as compared with $748 million at the end of 1959.

In the company's annual report, Douglas and his father, Donald W. Douglas, Sr., chairman of the board, mentioned that DC-8 orders have been "disappointingly slow," but pointed out:

". . . Whether there is to be a significant change in our prospects for commercial aviation business—passenger or cargo types, DC-8s or Caravelles—will be determined largely by factors at work in the airline industry. Financial problems encountered by the carriers in connection with the change to jet aircraft have been aggravated by recessive trends in the national economy, increased competition and an unsatisfactory fare structure.

"This situation has produced consortiums among foreign carriers and prospective mergers at home, which may have the effect of shrinking the market for aircraft."

Future Prospects

Looking to the future, Douglas told the society that "we expect a profit in 1961, despite less volume of about $800 to $900 million." Part of the reason for drop of volume will be the slowdown in DC-8 orders, military contract phase-outs (such as the C-133 and A3D) and a Douglas move to more advanced research and development work. Other projects planned by Douglas include:

- **Douglas possibly may enter** the business plane field. Company has been talking with Piaggio to develop and market a light aircraft, with Douglas handling U. S. and European sales efforts (AW Nov. 7, 1960, p. 23).
- **Heavy concentration** on design and construction of a commercial jet cargo transport which will be entered in military competition, primarily for U. S. Air Force. Douglas called this field the "new frontier of aviation" and warned that unless the U. S. "gets cracking" on development, "the Soviets may well show us their heels. Already they have more modern turbine-powered cargo aircraft in production and under development than we do."
- **Navy Missileer launching aircraft** for Eagle air-to-air missile, which Douglas said also could become an all-purpose airplane for the fleet, is well into development phase although it is "still some distance down the road as far as production was eliminated by the Eisenhower Administration but Douglas was optimistic that this would be restored.
- **Skybolt air-launched** ballistic missile for Boeing B-52H and British Vulcan bombers underwent a cutback by the Eisenhower Administration but Douglas said he is "bullish" about gaining considerably more research and development funds.
- **Diversification** is following a "middle course" at Douglas, but, the president said, the company is currently negotiating with Midwest Instruments, Inc., Tulsa, Okla., which he said needs "money, management and new products." Initially, Midwest would produce a navaid checkout device and digital tape recorder for Douglas, if the deal goes through. Company also got into the nuclear propulsion field last year by

No Lockheed Dividend

Burbank, Calif.—Directors of Lockheed Aircraft Corp. last week voted not to declare a dividend for the first quarter of 1961 because of "substantial losses recorded in 1960," according to Robert E. Gross, board chairman and chief executive officer. He said Lockheed will show a net loss for 1960 of about $43 million, noting that the last six months were profitable and net earnings after taxes for that period, taken alone, will approximate $12.5 million. Gross added: "With a return to sustained profitable operations, the directors will consider the resumption of dividends at the earliest possible time deemed prudent."

Lockheed C-140 JetStars Prepared for MATS Delivery

Lockheed C-140 JetStars fly in formation over northern Georgia. Powered by four Pratt & Whitney JT12A-6 turbojets, each developing 3,000-lb. thrust on takeoff, the first plane is scheduled for delivery to Military Air Transport Service in September. Six of the aircraft have been purchased by MATS for its special air mission wing, on a $94-million contract. The new jets will replace some of the wing's 15 twin-engine Convair C-131s on short-to-medium-range missions involving transportation of government officials and foreign dignitaries.

helping to organize Astropower, Inc., as a subsidiary.

• **Development of a new version** of the A4D Skyhawk, designated A4D-5, with greater range and payload than its predecessors, is under way and production is expected to continue through 1965.

• **Test results** of Army Nike Zeus have been "highly encouraging" and an actual intercept attempt, using an Atlas ICBM as a target in a South Pacific shot, can be expected "soon." Zeus would be fired from Kwajalein Island.

• **Douglas is concentrating** on applications of nuclear power in initiating a number of studies aimed at obtaining contracts for scientific satellites and space systems, involving both company and government funds.

NASA Narrows Field On Saturn Tank Award

Washington—Contract for $2.25-million to construct 42 booster tanks for five Saturn launch vehicles will be awarded within the next two weeks by National Aeronautics and Space Administration to one of four companies selected for final evaluation.

Boeing Airplane Co., Chance Vought Corp., Chrysler Corp. and Martin Co. were chosen from among 18 companies which submitted proposals.

The contract will call for delivery of 70-in. diameter tanks, starting in mid-1962. Forty tanks will be used for five Saturn vehicles, and two will be spares. Each booster stage consists of eight 70-in. tanks and one 105-in. tank, which contains liquid oxygen. Four of the smaller tanks contain kerosene fuel, and the others liquid oxygen. NASA will assemble the tanks into the 22-ft. S-1 booster stage.

United's JT8D Development Costs Set at $75 Million in Five Years

Company financed engineering charges of $50 million in 1961 and $60 million in 1962 will continue to hold down United Aircraft Corp. profits, but United Chairman H. M. Horner expects net income to begin to rise again in 1963.

Prime reason for these increased charges will be the development expenses of the Pratt & Whitney JT8D turbofan engine, sold in the Boeing 727 medium-range transport after what Horner described as a "real tough competitive fight with a combined General Motors and Rolls-Royce" engine proposal. Horner placed development costs of the engine at $75 million—$15 million annually spread over five years.

United's company-financed engineering expenses have risen steadily from $11 million in 1958 to $28 million in 1959 and $40 million in 1960. In addition, the company spent $35.5 million in 1960 for new facilities, compared with $23 million in 1959. Of the 1960 total, $15 million went for engineering buildings and equipment for powerplant development in Connecticut, California and Florida. About $9 million went for modernizing production equipment and $7 million for new plants in Connecticut and California for the Norden Division.

This year, United expects to spend $35 million for facilities, mostly for production equipment modernization.

Horner noted the impact three years ago of a military decision to allow only certain company originated R&D projects to be covered in accross-the-board engineering absorption. United is being pinched further by an extension of this decision last year in which company cost sharing was required even for those projects the military agreed to support. Horner told AVIATION WEEK that the latter decision has forced United to abandon entirely some projects that the company could not support alone.

Horner, speaking to the Boston Society of Security Analysts, estimated 1960 sales would be slightly under a billion dollars, and that earnings would drop to $14 million—"just about covering our common dividend." Last year, United had sales of $1,080,980,782 and earnings of $28,638,353.

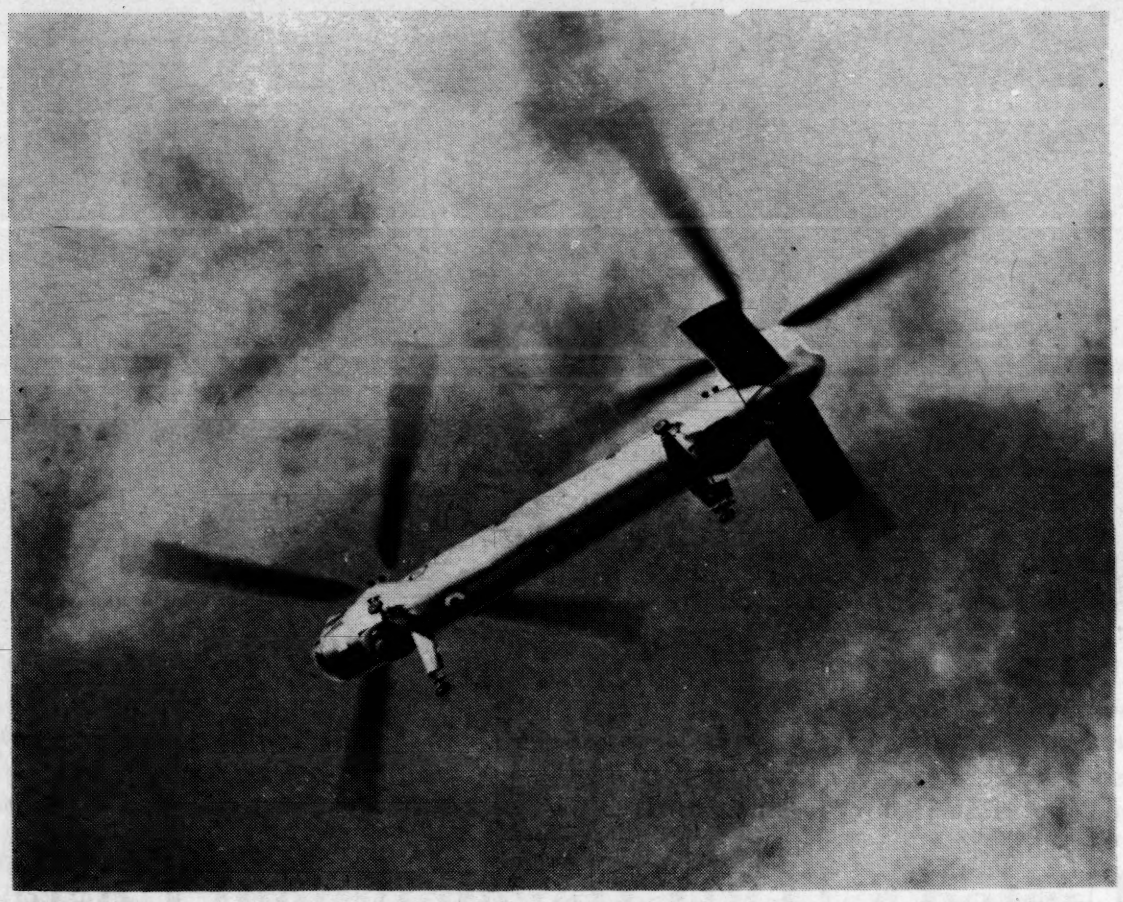
Earnings for the next two or three years are expected to exceed United's $2 a common share annual dividend, even after absorption of increasing engineering costs.

If the outlook continues more or less as it is now, Horner said the directors would probably continue the $2 dividend rate.

United sales should remain at the billion-dollar level for the next two years and should improve later as R&D programs begin to mature, Horner said.

Bank loans continue to rise for United. At year-end they stood at $113 million compared with $102 million last year, but the larger total now includes a $50-million seven-year term loan, where last year's figure was all short-term credit. Horner said United is considering a $50-million bond issue to replace the term loan.

Backlog at Dec. 31 was $1,150 million, a slight increase from a year earlier.



WESTLAND is emphasizing development of the stub-wing variant of the Bristol Belvedere helicopter—now the Westland 194—and has moved it into a top priority project. This version is powered by de Havilland Twin Gnome turboshaft engines and fuselage is being lengthened to 80 ft.

British Stop Work on Westminster

London—Work on the Westland Westminster helicopter has been suspended owing to lack of British military support, according to a recent annual statement by the company.

The Westminster, the Fairey 60-seat Tyne-powered Rotodyne and the Bristol 194 were referred to in this statement as three large transport helicopters in varying stages of design and development.

"Very detailed discussions," the report stated, had been taking place with the Air Ministry and the civil operators during the last few months regarding helicopter requirements and the importance of a decision from these users "cannot be over-emphasized".

Westland probably will develop only one of these projects, and although it appears that proposals based on all three transports have been submitted to the Air Ministry, the company is definitely encouraging development of the Westland 194.

The emergence of this design into a top priority project may have resulted from recent board changes affecting the technical posture of the company. In the new organization, Lewis Boddington, who was director-general of aircraft design and development at the Ministry of Aviation, became technical director-development and Raoul Hafner, former chief of Bristol's helicopter division, became technical director-research. The Belvedere 194 clearly embodies much of Hafner's thinking on the devlopment of stub wing helicopters which he indicated to AVIATION WEEK nearly three years ago.

It is unlikely that Westland will start production of any transport helicopter without substantial government support.

House Democrats Organize Committees

Washington—House Democrats last week re-elected Rep. Overton Brooks (D.-La.) chairman of the House Committee on Science and Astronautics and named five new Democratic members to fill vacancies on the committee. Republicans are expected to make their committee assignments this week.

New House space committee Democratic members, all lawyers, are Reps. Bob Casey (D.-Tex.) former state representative and county judge; James C. Gorman, (D.-Calif.) former Los Angeles city councilman; John W. Davis (D.-Ga.) former circuit judge; William J. Randall (D.-Mo.) former judge in Jackson County, Mo., and William Fitts Ryan (D.-N. Y.), former assistant district attorney of New York City.

Rep. Carl Vinson (D.-Ga.) was renamed chairman of the House Armed Services Committee, and Reps. Victor Wickersham (D.-Okla.) and Otis G. Pike . (D.-N. Y.) were named new Democratic members of the committee.

Rep. Thomas E. Morgan (D.-Pa.) was re-elected chairman of the House Foreign Affairs Committee while the new Democratic members are Reps. Robert N. C. Nix (D.-Pa.), Thomas F. Johnson (D.-Md.), and John S. Monagan (D.-Conn.).

Rep. William L. Dawson (D.-Ill.) will again head the House Committee on Government Operations, and Rep. Oren Harris (D.-Ark.) was renamed chairman of the House Committee on Interstate and Foreign Commerce.

Ling-Temco Claims 455,000 Vought Shares

Dallas, Tex.—Chance Vought Corp. President Fred O. Detweiler late last week fired back at a Ling-Temco Electronic, Inc., claim that it now has in excess of 455,000 shares of Chance Vought common stock by stating that "I retain my confidence that this raid on Chance Vought with borrowed money will not succeed."

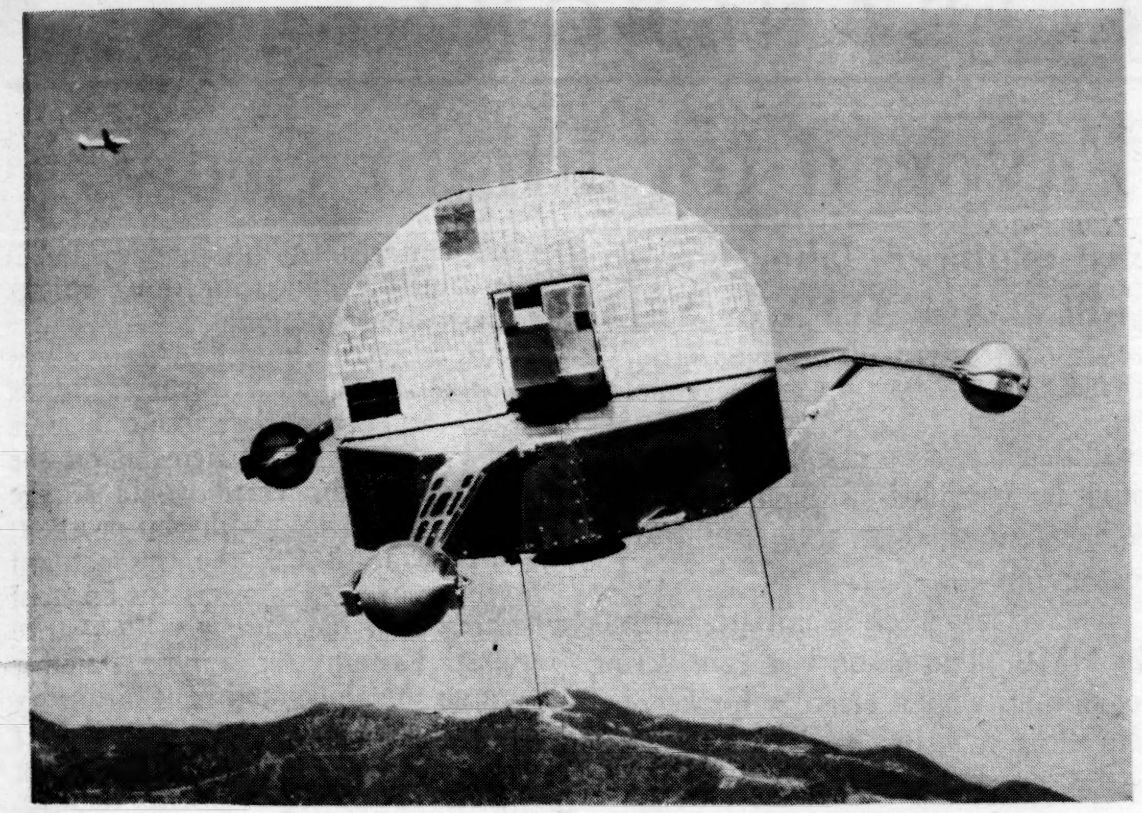
Detweiler's reference to borrowed money is interpreted by Wall Street sources to mean not only Ling-Temco's recent $10-million increase in its line of bank credit but also support from the investment firm of Lehman Bros., represented on Ling-Temco's board.

Latest announcements by both sides in the course of the struggle over the future of Chance Vought (AW Feb. 6, p. 30) came the morning of Feb. 9, with Ling-Temco stating that the company, its president, James J. Ling and an associate (believed to be a Ling-Temco director), has in excess of 455,000 shares of Chance Vought common stock through direct purchases "in the public market and through a public tender dated Jan. 23, 1961, to the owners of Chance Vought common stock." The tender offer expired at 2 p.m. CST Feb. 8, and Ling-Temco announced that it was not its intention to extend the offer further.

Detweiler's statement came shortly after the Ling-Temco announcement of the number of Chance Vought shares it had obtained, and he noted that "Ling-Temco is now announcing ownership of about the same amount of stock published estimates indicated they had several weeks ago, so they must have been disappointed at the number of shares tendered."

As of Jan. 31, 1961, the number of outstanding shares of Chance Vought common stock totaled 1,191,315.

Ling-Temco has filed a Form 14B with Securities and Exchange Commission, giving notice that it intends to make a proxy solicitation of Chance Vought stockholders. A Chance Vought source indicated late last week that his company intends to file a like form "if and when the time comes to make a proxy solicitation."



First Photo of S-16 Solar Observatory

First photograph of National Aeronautics and Space Administration's Orbiting Solar Observatory (S-16) scheduled for launching from Cape Canaveral by Thor-Delta booster in April (AW Jan. 30, p. 19). This satellite will be first of probably four of this type for investigating solar phenomena. Purpose of first shot will be to demonstrate stability of the platform and operation of a sun seeker, believed to be capable of locating the center of the sun to within ½ deg. Satellite's attitude will be controlled by compressed gas within balls at ends of three folding arms located at 120-deg. angles around the perimeter of the vehicle. Designed and built by Ball Bros. Research Corp. under contract from NASA, the satellite contains eight compartments for scientific experiments.

New Superconductor Developed by BTL

New superconducting (cryogenic) material which can generate extremely large magnetic fields without consuming electric energy, except to initially establish the field, has been developed by Bell Telephone Laboratories.

Using a compound of niobium and tin, treated by special metallurgical processes, BTL predicts that steady state magnetic fields of 88,000 gauss or more can be obtained. Previous materials could produce fields of only a few thousand gauss before superconducting properties disappeared.

New superconducting magnets may find use in thermonuclear (fusion) power experiments as a means of producing a powerful magnetic enclosure for the plasma. The new technique also is expected to extend the operating frequency range of Maser and traveling wave tube amplifiers, both of which require magnetic fields for operation.

Equally important use will be in experimental physics where high cost of producing strong magnetic fields has been a limiting economic factor. A conventional magnet now used by BTL scientists at the company's Murray Hill, N. J., facility consumes 1.5 megawatts of electric power, 25% of the total power consumed by the entire facility, and requires thousands of gallons of cooling water per hour. A superconducting magnet of comparable strength would not require cooling water and would consume no electric energy once the field had been established. It would, however, require cooling equipment to lower magnet temperature to 18K, where niobium-tin compound becomes superconducting.

BTL scientists have developed techniques for producing a ductile compound of niobium and tin, suitable for preparation of wire, without sacrificing its superconducting properties.

Second Orbital Try Scheduled for Scout

Washington—Second attempt to qualify the four-stage, solid fuel Scout as a satellite launch vehicle is scheduled this week from Wallops Island, Va., with an 80-lb. payload containing a 12-ft. inflatable sphere.

The payload will be essentially the same as the one carried in the first satellite launch attempt in December. The launch was unsuccessful because of a faulty ignition signal to the second-stage motor (AW Dec. 12, p. 33). Because the ignition operated normally on earlier ballistic flights July 1 and Oct. 4, no changes are being made in the system for the coming launch.

News Digest

Edward G. Uhl, former vice president and San Diego Division manager of the Ryan Aeronautical Corp., was elected president and chief executive of Fairchild Engine & Airplane Corp. last week, effective Feb. 20. He replaces Sherman Fairchild, who continues as chairman of the board.

British Overseas Airways Corp. has indicated that it intends to buy three additional Boeing 707-420 jet transports. While no order has been placed, BOAC board chairman Sir Matthew Slattery said recently in Seattle that the airline is considering asking the British government for authority for the purchase.

Kaman Aircraft and Grumman Aircraft Engineering Corp. are cooperating in a proposal in the Army light observation helicopter competition. Kaman would be prime contractor and systems manager in event of award, but in a covering letter in its proposal the Grumman agreement to provide engineering and productive capability is cited.

Rear Adm. Rawson Bennett III, Chief of Naval Research for five years, has retired, and he has been succeeded by Rear Adm. Leonidas D. Coates, formerly assistant for PQANS in the office of the Deputy Chief of Naval Operations (Development).

First Polaris A2 advance-range missile to carry a complete inertial guidance system failed in a launch attempt last week when the second stage was launched first. Upper stage flew several hundred feet into the air and crashed about 700 yards from the pad.

NAP-100 nuclear-powered thermoelectric generator, capable of producing 150 w. and designed to operate continuously for one year, is now undergoing test by Air Force Special Weapons Center. Developed by Westinghouse Electric Corp., the 40-lb device is for use with unmanned radio beacons and weather stations. It measures 16 in. dia. by 10 in. high, uses 144 small thermo-electric elements which are heated to temperature of about 1,000F by Curium 242 radioactive isotope.

Soviet Union charged last week that a French military aircraft fired on a Russian transport carrying Soviet President Leonid Brezhnev on a visit to Africa. Alleged incident occurred over the Mediterranean about 80 mi. north of Algiers.

Single Union Favored for Flight Crews

United decision threatens engineer labor group; the airline's flight crews will choose ALPA or FEIA.

By Robert H. Cook

Washington—National Mediation Board decided last week that United Air Lines' pilots and flight engineers should be classified as flight-deck crew members and represented by a single union, a move which severely threatens the future of the separate flight engineers union.

Flight Engineers International Assn. prepared last week to initiate a strong fight against the policy recommended by NMB. The union was considering means of reversing the NMB-United decision, as well as strategy for keeping the single representation policy from spreading to other carriers which currently have pilots and engineers covered by separate unions.

The long-standing battle between the Air Line Pilots Assn. and engineers union over cockpit jurisdiction took this latest turn when the NMB ruled on a petition, filed 17 months ago by ALPA, which asked a "class and craft" determination on whether United flight-deck crew members belong in a single bargaining unit or separate unions.

Secret Ballot Election

The ruling last week paves the way for NMB to appoint a mediator who will conduct a secret ballot election with ALPA and FEIA members at United to determine which union will represent the whole group. An ALPA victory seems inevitable, since there are 1,566 pilots and 624 flight engineers. The engineers then would be added to the bottom of the ALPA seniority list.

With all but 17 of the United flight engineers already pilot qualified, NMB emphasized that the principle of one union in the cockpit is further strengthened by the fact that the growth of the airline industry in the past 10 years and the use of jet aircraft has resulted in the flight engineer's duties more closely resembling those of a pilot than a mechanic.

At United, where both pilots and engineers have received training in each other's duties, NMB said the "cross training and cross utilization" of the flight-deck crew has "destroyed any distinguishing features between members of the crew upon which a class or craft determination would be possible."

Beyond the loss of the unit at United, the flight engineers union fears the NMB ruling may trigger a series of similar ALPA petitions from other airlines, thus setting the stage for almost complete absorption of FEIA chapters into ALPA.

FEIA points out its members at United will be in a particularly precarious spot if placed on the bottom of ALPA's seniority list, since they would be the first ALPA members subject to any furlough orders by the company. This possibility is heightened by the pending Capital Airlines-United merger which FEIA says will require the seniority integration of 820 Capital pilots into the ALPA ranks at United.

FEIA studies of a combined ALPA seniority list, including the engineers who would be absorbed into the pilot union, indicate that the merged airline might have to furlough as many as 300 ALPA members, all of whom would be flight engineers formerly members of FEIA.

In a move to block implementation of the NMB ruling and avert wholesale filing of similar petitions by other ALPA chapters, FEIA has called a meeting of its Master Executive Board this week and is expected to seek a temporary injunction against the ruling.

FEIA might also decide to place its running battle with the pilots union in the national spotlight by calling strikes against American Airlines, National Airlines, Eastern Air Lines, Pan American World Airways, Trans World Airlines and Western Airlines. Since final pay and working condition agreements have not been reached with these carriers, the union points out it could legally set strike dates over these issues on most of them.

Controversy over the pilot-engineer issue is reflected in the recent endorsement of a resolution by the International Transport Workers Federation condemning several airlines for replacing specialist flight engineers with systems-trained pilots. The ITWF voted last month to enforce its policy against Scandinavian Airlines System, which it charged has not been following an agreement against this practice and is consequently influencing other airlines to take similar action.

Any decision by FEIA to call an across-the-board strike against the six U. S. carriers as a last resort measure would create a heavy demand on the union's finances, which would require a large loan. Faced with this prospect, FEIA might turn to the International Brotherhood of Teamsters for financial backing as it did during a 1958 strike against Eastern Air Lines. Another move in this direction might ultimately result in FEIA severing its AFL-CIO affiliation and joining the Teamsters.

With Teamster financial backing, FEIA won a 38-day strike against Eastern called after the airline demanded that a new flight engineer contract require all FEIA members to be pilot qualified.

Cites Example

As a typical example of what it fears may happen if the NMB ruling is enforced, FEIA points to its failure to win a strike last year against Continental Airlines. Out of a total of 22 strikers, seven elected to accept a company offer of severance pay and resigned, while the remaining 15 agreed to take pilot training and join the pilots' seniority list. Six of the 15 are serving as flight engineers on turbojets, but the rest, four of whom had been top seniority engineers, have been assigned as junior copilots on DC-3s with a pay scale several hundred dollars less than they received as engineers.

NMB noted that it assigned the United class and craft case to a neutral three-man panel because it was the first time the Board had been required to rule on such a matter. In the past, the Board said, its rulings on airline labor unions involved only a determination of the organization chosen to represent a group previously agreed upon. Rulings on railroad matters also were handled directly by the Board, since the industry's work patterns and job duties were considered fully established and uniform.

In contrast, the Board noted that the airline industry is still growing, and technological changes, new equipment, varying company policies, labor agreements and government regulations have exerted such an impact on the role of the flight engineer as to even make the name a "misnomer" on some airlines.

While, "initially there was no question but what he was simply an airborne mechanic," said the Board, the

selection, training and use of flight engineers in the past have resulted in the position being more closely related to pilot than mechanic duties, since in today's turbojets in-flight repairs are "virtually impossible," with any needed repairs more properly a function of ground mechanics.

The Board also noted that this shift of emphasis for the flight engineer has been reflected by the Federal Aviation Agency, which last October transferred its flight engineer training programs from the maintenance to the operations division.

FAA said this was done to eliminate much administrative and liaison work, since the training of all crew members must be synchronized.

Industry Policies

Industry policies on the flight engineer likewise differ to a great extent, said NMB, since a majority of carriers still retain the original specialist concept for flight engineers, while others recruit engineers from their pilot ranks and still others, such as United, offer dual training to the engineer on the basic premise that he will eventually progress from engineer to copilot to captain.

Because of this lack of unanimity among the industry, along with evident disagreement among many United flight engineers, some of whom look upon their position as a stepping stone to a captaincy while others do not, and because of the constantly changing character of the airline industry, the National Mediation Board ruled that it could find no fundamental principle upon which to determine that the flight engineer on United is required to be considered as a separate class or craft for representation purposes.

National to Sell Its Pan American Stock

Washington—National Airlines has told the Civil Aeronautics Board it intends to dispose of 400,000 shares of Pan American World Airways stock it now holds as a result of stock exchange agreements between the two carriers.

National said it would offer the stock to Pan American, and if Pan American does not buy it, the stock will be sold to underwriters for public distribution. In its notice to the Board, National said this action was being taken pursuant to CAB orders and would be carried out according to the provisions of the option and stock agreement between the two carriers.

The Pan American stock held by National is now pledged as collateral for demand loans totalling $4.5 million, and the proceeds of the sale would be used to retire the loans.

Examiner Recommends Against Trunk-Local Airline Competition

By L. L. Doty

Washington—Drive by local service airlines to win a more prominent position in high-density traffic markets now dominated by trunklines received a setback last week when Civil Aeronautics Board Examiner William F. Cusick urged that the Board adopt a policy protecting trunklines from local service competition.

In his initial decision in the Pacific-Southwest Local Service Case, Cusick called on the Board to provide trunk and regional carriers with a "clear understanding" of its policy on subsidized local service competition. He then made recommendations to the Board as to what that policy should be.

Stressing that local service carriers complement rather than duplicate trunk carrier services, he said that there is nothing in previous Board opinions that suggests local service airlines should be placed on a "competitive parity with trunklines for terminal-to-terminal traffic even in short or medium-haul, high density markets." He added, "indeed, just the reverse appears to be true."

Views Elaborated

Cusick underscored his views by recommending that TWA be granted turnaround authority on the Los Angeles-San Francisco route and that Western Air Lines be awarded a new route between San Francisco and Las Vegas. These are the two major proposals in his initial decision.

He said that the position taken by the carriers in the case "involves a head-on collision between two schools of thought relating to the part local service carriers should play in competition with trunklines." He added that the question is of major importance in the Pacific-Southwest Case, in which several local service carriers "are seeking authority to operate extensive point-to-point competition, on a nonstop basis, with existing and proposed trunkline services."

Cusick admitted that no hard rule could be established which would pre-empt high-density markets for the sole use of trunk carriers or would open such markets to local service carriers. He said that there will be cases in the future where exemptions to any Board policy on the issue of local service competition with trunklines must be made. However, he urged that the Board take a firm stand on the issue and added:

"Otherwise, the management and planning staffs of all certified carriers will be operating in a vacuum insofar as they may contrive to execute plans for future expansion of activities, acquisition of additional aircraft, finances, etc."

He then noted that ". . . in a period marked by a general transition from older piston-type equipment to newer and faster jet-engine aircraft, requiring great expenditure of time and effort, forgetting for the moment the vast capital investment in such equipment, the carriers are entitled to know the Board's position in relation to such matters, at least for the immediate future."

He said he had no dispute with the principle that local service carriers compete for traffic on high-density route segments when they are required to make intermediate stops between terminal points. He added that "the controversy rests purely on whether local service carriers should be given terminal-to-terminal nonstop authority in parallel competition with trunkline operators.

Cusick cited such local service arguments as that set forth by Pacific Air Lines in which it contends that trunkline turbojet aircraft are not economically intended for high-density, short-haul markets. However, he noted that the Board has generally supported the position advanced by the five trunk carriers participating in the hearings that there has been a longstanding policy against competition between local service and trunkline carriers in short-haul markets.

Decision Review

He said that review of Board decisions indicates that they tend to support arguments advanced by the trunklines in opposition to any local service competition. Trunk carriers held that two-engine piston engine equipment and F-27 turboprop transports could not compete with Boeing 707s, Douglas DC-8s, Lockheed Electras and Vickers Viscounts which the trunks proposed to use in the various markets. They also said that local service participation in high-density markets would be achieved at the expense of traffic development in smaller communities.

The trunks further held that local airline certification in major markets would disrupt close cooperation between the two types of carriers. Cusick reached this conclusion:

"Irrespective of the relative merits of newer aircraft recently introduced by the local service carriers such as the

British Transport Realignment

London—Great Britain's two major airframe groups—Hawker Siddeley and British Aircraft Corp.—may align their transport designs, dropping at least two projects to avoid a head-on sales conflict, particularly in view of mounting U. S. competition.

Indication of future liaison between the two groups probably will show up in production decisions involving the Vickers VC. 11, de Havilland Trident, the BAC 107 and the Avro 771.

It appears that Hawker Siddeley would continue the Trident, dropping the Avro 771; Vickers would abandon the VC. 11 and expedite construction of the BAC 107. A major factor affecting the moves is the entry of the Boeing 727 into the medium-range turbojet transport market.

The inter-corporate liaison apparently was initiated by Hawker Siddeley, which formed a Committee of Advanced Study to explore this facet, thereby meeting foreign competition and minimizing rivalry with BAC. Conflict became evident when BAC developed the 107 feederliner at the same time as Avro put the 771 on the board; both are powered by Bristol BS.75 rear-mounted turbines. In the medium-range category, BAC started development of the VC.11 after de Havilland entered the Trident and the Boeing 727 was well under way.

De Havilland has been assured of government support in manufacture of the Trident.

Company could proceed up to breakeven point with manufacture, considering the 25-plane order placed by British European Airways.

F-27s, which may nor may not be competitive with equipment operated by the trunk carriers, the fact remains that the Board has rejected, with almost rigid consistency, proposals which would place local service carriers in direct competition with the trunk carriers."

New Routes Recommended

Here are the principal route adjustments recommended by Cusick.

• **Bonanza Air Lines** would be authorized to operate nonstop between Las Vegas and Los Angeles after two daily round trips were operated to all intermediate points. Burbank would be eliminated as a co-terminal.

• **Pacific Air Lines'** Monterey-Bakersfield route would be changed by adding Fresno as an intermediate point. Service from Palmdale/Lancaster would be extended to San Diego via Burbank and Long Beach for five years, but service to and from Los Angeles on flights serving San Diego would be prohibited. Paso Robles and San Luis Obispo would be served by Pacific at their respective airports.

• **Western Airlines'** route between Los Angeles and Seattle would be extended from San Francisco to Las Vegas. A new segment would be added between Los Angeles and Reno via Sacramento, subject to a restriction prohibiting service between San Francisco and Sacramento. Route between Salt Lake City and San Diego would be consolidated with the Los Angeles-Seattle route to permit nonstop San Diego-San Francisco service. Long Beach would be added as a co-terminal with Los Angeles.

• **Trans World Airlines** would be authorized to operate turnaround service between Los Angeles and San Francisco, and all flights between Fresno and Las Vegas would have to make an intermediate stop at Los Angeles. Currently, TWA can operate flights between Los Angeles and San Francisco only as a segment of transcontinental flights.

• **United Air Lines** would lose Salinas as an intermediate point on its West Coast route, and the intermediate stop, Monterey, would be designated Monterey-Salinas.

South Pacific Charges Secret Bilateral Pact

Washington—Civil Aeronautics Board hearings on Qantas Empire Airways' application to establish Tahiti as an intermediate point on its South Pacific route closed last week amid charges by South Pacific Air Lines that the U. S. and Australia had negotiated a secret agreement in 1957.

An official State Department interpretation of the 1957 bilateral agreement between Australia and the U. S. said that Tahiti could be served by both U. S. and Australian carriers as an intermediate point on the South Pacific route. South Pacific, which operates one round trip weekly between Tahiti and Honolulu, termed the agreement "improvident" and charged that Australia has not complied with its provisions and, therefore, is not entitled to demand compliance by the U. S.

South Pacific said that the agreement to name Tahiti as an intermediate point was contained in a "secret minute" which, until several months ago, was unknown to the carrier. It added that if the government should grant Qantas' application, the effect would be "disastrous to South Pacific" and would create a subsidy need of $3 million annually.

South Pacific held that there could be "no reasonable excuse for our not having been made aware of this so-called 'secret minute' long ago. As early as 1954 and throughout 1955 and 1956, South Pacific Air Lines worked actively and openly with various government people and departments to inaugurate service with flying boats on its certificated routes."

At the present time, TAI—independently owned French airline—is authorized to serve Tahiti on its route between Australia and Los Angeles.

Murphy Named to CAB; Boyd Is Chairman

Washington — Robert T. Murphy, Senate aviation subcommittee counsel, was named last week to the Civil Aeronautics Board by President Kennedy, who also designated Alan S. Boyd chairman of the Board.

Murphy, a Democrat, will replace Republican John S. Bragdon, whose term expired last Dec. 31. Boyd, a Democrat currently serving a term that expires Dec. 31, 1962, will replace Whitney Gillilland, a Republican, as chairman. Gillilland will remain a Board member, with his term expiring Dec. 31, 1965. Murphy was assigned as counsel to the Senate Interstate and Foreign Commerce Aviation Subcommittee in 1957, and helped draft the Federal Aviation Act of 1958 and other legislation pertaining to the aviation industry. He has been special counsel to full committee since 1956.

The new CAB member was born at Providence, R. I. March 5, 1915, and he received a Bachelor of Arts degree from Providence College in 1936 and his law degree from Georgetown University Law School.

Murphy was a tax attorney for Rhode Island in 1942-43. Then he was an enforcement attorney for the Office of Price Administration, and from 1944 to 1945 he was chief counsel of the Senate Campaign Expenditures Committee. From 1945 to 1952 he was in private law practice in Washington, and he was a public member of the U. S. Coast Guard National Appeal Board for security cases from 1952 to 1956.

Boyd, who has served as chairman of the Florida Railroad and Public Utilities Commission, at 38, is the youngest member of the CAB. As chairman he will have an opportunity to try his ideas on how the regulatory agency should be administered (AW May 2, 1960, p. 38).

He has said that the CAB's regulatory procedures are too lengthy, but that the cause can be cured from within the organization.

Flight Characteristic Modifications Slated for All Boeing Jet Airliners

All airline customers with Boeing 707, 720 and 727 jets in service or on order will eventually be flying aircraft modified under the manufacturer's flight characteristics improvement program (AW Feb. 6, p. 43), which includes changes in the vertical fin.

Some carriers are installing the modifications with kits provided by Boeing; other airplanes are being modified in the production line or flown to Seattle for modification.

Program Provisions

The program provides for extension of the vertical fin; installation of a ventral fin; fully powered rudder; modification of aileron control system to reduce lateral wheel force at all speed ranges; modification of rudder trim control mechanism; modification of some flap mechanisms.

Most important changes, according to Boeing engineers, were the rudder modifications, which are said to have corrected a tendency of the rudder to trail in a yaw or sideslip condition. This "floating rudder" situation arose when, in a sideslip or yaw, aerodynamic pressure pushed the rudder in the direction away from sideslip, reducing its keel effect and thereby the aircraft's directional stability. Full boost power now is said to keep the rudder centered in the slip condition.

The ventral fin also improves directional stability at high angles of attack and limits the angle of rotation at takeoff.

Provide Free Kits

Where aircraft already were delivered to the airlines, the program was voluntary but highly recommended by Boeing. The manufacturer provides free kits to airlines agreeing to make all the modifications. If desired, the planes may be returned to Boeing for rework with a charge for labor but not for parts. Boeing can handle four or five aircraft at a time in this program. Modifications to aircraft on the production line have been made since early last year.

A number of Boeing's customers received, or will receive, aircraft already modified before delivery. These include British Overseas Airways Corp., Cubana, Eastern Air Lines, Ethiopian Airlines, Irish Airlines, South African Airways, United Air Lines, Varig, and Western Air Lines.

American's 707-120s and 720s are being modified at the same time they are in Seattle for turbofan installation. Air France is modifying seven of its 707-320s at Orly with the Boeing kits. Air India International's 707-420 modifications were done by Boeing as aircraft were returned to Seattle for the purpose. Braniff's 707-220 aircraft will be modified by Boeing, with the first scheduled at Seattle later this month.

Continental probably will handle its own 707-120 work with the kits. Lufthansa's two originally unmodified 707-420s have been modified at Hamburg. Pan American is doing its own work at Miami during major overhaul periods. Qantas will return its 707-120s to Boeing beginning in late July. Four of Sabena's 707-320s were modified by the airline at Brussels.

Trans World is handling modification of all but two of its 707-120s and 707-320s at Kansas City as the airplanes come up for major overhaul.

Jet Transport Orders

New and additional orders for jet transports have been placed by several foreign flag airlines, boosting sales of Boeing, Douglas and Sud Aviation jets.

A new order for two Boeing 707-420s has been placed by Ghana Airways, as predicted by Aviation Week (Dec. 12, p. 39). An additional 707-420 has been ordered by El Al Israel Airlines, bringing that carrier's total order of the aircraft to three.

Avianca, the Colombian airline, has received an Export-Import Bank credit for the purchase of two Boeing 720s, with delivery expected late this year. KLM Royal Dutch Airlines has ordered a 13th Douglas DC-8 for 1962 delivery. The additional DC-8 will be turbo-fan powered, as are five DC-8s scheduled for delivery to KLM this year.

Four additional Sud Aviation twin-jet Caravelles have been ordered by Scandinavian Airlines System for operation by Swissair. With Alitalia's recent additional Caravelle order (AW Feb. 6, p. 36) and Iberia's recent order for four of the French jets with option on four more, Caravelle sales have reached a total of 116 plus 29 options.

Individual Ticketing Increased by MATS

Washington—Military Air Transport Service is buying overseas airlift for an increasing number of individually-ticketed military personnel at rates substantially higher than 2.9 cents per passenger mile, the minimum rate set by Civil Aeronautics Board.

Contracts signed with Pan American World Airways and Trans World Airlines bring to four the number of U. S. carriers participating in the new program. Pan American's agreement is effective Feb. 15, TWA's Mar. 1. Last December, MATS concluded the first similar arrangements with Alaska Airlines and Northwest Airlines.

Late last week, MATS had placed passenger service orders worth $349,500 with Northwest, $62,236 with Alaska and $53,324 with Pan American. Under the two new contracts, one-way fare between New York and London is $148 for a single passenger traveling economy class. These military passengers travel on scheduled airline flights.

Based on a distance of 3,500 stat. mi. between the two cities, rates paid Pan American and TWA by MATS will average slightly more than 4.2 cents per passenger mile until June 30, when the agreements are scheduled to expire. Meanwhile, the four participating airlines still are eligible to bid for monthly, quarterly or annual charter-type airlift contracts as these are needed by MATS.

Terms of the individual ticketing contracts require that Pan American and TWA notify MATS at least 60 days in advance of seats available in a given month for military use. After receiving this notification, MATS issues service orders on the fifth day of the month preceding the month of operation, informing the airlines how much of the available space it will purchase.

Should the Department of Defense declare a national emergency, the carriers also guarantee the government that additional seats will be offered. This "expansion capability," according to the contracts, would equal half the space purchased by MATS in the month prior to the declaration of emergency.

NAFEC Tour Planned For Operations Group

Washington — Federal Aviation Agency will give 450 of its top field operations specialists a three-day tour of the National Aviation Facilities Experimental Center at Atlantic City, N. J., to familiarize them with automated traffic control devices undergoing tests there.

Highlight of the inspection, scheduled to begin Feb. 14, will be the semi-automatic Data Processing Central System, which FAA plans to install in Boston's Air Route Traffic Control Center next year. Those selected for the briefing include chief controllers, area and field maintenance supervisors and Federal Aviation Agency military liaison officers.

Snow Storm Cancels 2,700 Flights At New York City Area Airports

New York—Cancellation here of 2,700 flights involving 100,000 passengers was caused by snow which hit the northeastern states on the weekend of Feb. 3-5.

Airlines serving the northeastern area took some consolation, however, from the fact that other means of transportation suffered too, putting many passengers in the backlog category rather than having them lost to trains and buses.

In New York, for example, movement of non-essential automobile traffic was banned on city streets following the storm. Train schedules were erratic and intercity buses unable to operate. Many passengers were unable to get from their homes to transportation terminals.

This meant that a number of passengers, instead of canceling their airline tickets and traveling by other means, remained in the city and eventually went out by air. For this reason, a fog which shut down the airlines would have been worse than the snow storm in some respects.

New York was out of airline action for a period roughly from Friday afternoon through Sunday, although some limited operations were sandwiched in for short periods. Boston was also among the airline cities knocked out by the snow over the weekend, and flights serving the northeast from other points also were canceled. By last midweek the airlines had managed to reposition their equipment and get schedules back to normal.

American Airlines, which develops about a quarter of its business at New York, normally handles about 4,500 departing passengers a day from this area. Loads following the weekend were well above normal, indicating that many people had not canceled but merely postponed their air trips. Last Monday, with three-fourths of normal schedules operating, American handled about 4,500 departures, or the normal number for 100% schedules. Other airlines also reported much heavier loads on trips following the shutdown.

Trans World Airlines carried only 75% of its normal domestic traffic for the four-day period Feb. 3 through Feb. 6, and had 116 cancellations during that period. TWA's international traffic volume was about 50% of normal during the same period.

Eastern Air Lines reported full loads on southbound flights following the weekend. Northeast Airlines also reported excellent southbound loads, and noted that the snowstorm, despite its problems, at least served as a good advertisement for Florida business.

Blockage of ground transportation by the snow brought some unusual problems, among them the difficulty experienced by airline personnel in reporting to their jobs. In New York last Monday, as flights were beginning to operate again, cars carrying flight crews were turned back by police enforcing the non-essential traffic ban. This was quickly corrected, however, and crews were allowed to proceed.

Eastern last Monday set up a special Martin 404 ferry service from Newark Airport to Idlewild for personnel snowbound in New Jersey.

In attempting to keep up with the snow removal job, Port of New York Authority worked extra shifts around the clock at the three New York airports. At Idlewild, 421 personnel, 55 pieces of airport equipment and 46 pieces of rented equipment were used. No cost estimate for last weekend was available, but the December snow removal figure was $186,000 at the three airports.

No estimates of airline costs in lost revenues and extra expenses were available, but the figure was considered to be in the millions.

Delta DC-8 Skids Off Dallas Runway

Dallas, Tex.—Delta Air Lines DC-8 Flight 921, carrying 109 persons out of Atlanta, Ga., left Runway 13 at Love Field some 2,700 ft. from touchdown, traveled a further 2,700 ft. on the runway shoulder, swerved into the mud and bogged down approximately 700 ft. from the northwest terminus, approximately 25 ft. off the right side of the runway on Feb. 6. Use of the sole instrument runway at this field was blocked to jet traffic until the airplane was towed out at approximately 7.30 p.m. Feb. 8.

Aircraft sustained only minor damage and no injuries were reported. Landing gear withstood shock of rapid deceleration in the mud, although the wheels were buried to the tops of the tires.

Flight 921 had an instrument flight rules clearance from Atlanta to Amon Carter Field, Ft. Worth. This airport was closed in by weather on arrival and the DC-8 was diverted to Love Field. The airplane was vectored by Dallas radar for an ILS approach on Runway 13-31. It had a quartering tail wind of about 7 kt. during landing.

Love Field, at the time of the landing, was experiencing snow and its runway was wet and slushy. According to passengers who had jet pilot experience, the engine reversers were applied just prior to touchdown and they said they felt little or no sensation that the brakes were effective, indicating that the airplane skidded off the runway.

They were extremely critical that only a single fire truck arrived at the airplane some eight minutes after it stopped off the runway and that evacuation of the airplane was not begun until some 30 min. after the airplane halted, when a conventional passenger stair was brought to the airplane.

Visibility at the time of landing was $1\frac{5}{8}$ mi. at the runway, with general visibility in the area at all four quadrants being one mile. Ceiling was 300 ft., with light snow falling.

Pilot Dismissal May Precipitate Strike

London—British Air Line Pilots Assn. (BALPA) is polling British European Airways' pilots on whether they favor strike action in protest against the dismissal of Capt. James Thain, pilot involved in the 1958 Munich air disaster (AW Dec. 12, p. 137). BEA pilots have been asked if a 24-hr. strike would be approved.

The pilots' union, in a yet unpublished letter, asked members to distinguish between BEA's action in dismissing Thain solely for breaches of company regulations and the controversies which surrounded the cause of the crash. "If the aircraft had not crashed, Capt. Thain would not have been dismissed," said a BALPA spokesman, "because these two technical points would not have been sufficient for dismissal."

The British pilot's union has expressed interest in reopening the accident investigation.

FAA Plans Symposium On Aviation Research

Washington — Federal Aviation Agency will hold its first Annual International Aviation Research and Development Symposium here Apr. 10-14 to discuss new developments and techniques, and their application to civil aviation.

Representatives of foreign governments and civil aviation groups have been invited to attend along with U. S. civil aviation organizations.

The symposium, sponsored by FAA's Bureau of Research and Development, includes four days of technical sessions, followed by a one-day inspection trip to BRD's facility at Atlantic City.

Congressional Prospects Are Dim For CAB Legislative Proposals

Washington—Heavy workloads already scheduled by Senate and House aviation subcommittees may delay Civil Aeronautics Board attempts this year to expand its authority over the airline industry through a new legislative program recently submitted to Congress.

A majority of the Board's proposals have been submitted in the past but they were not acted upon primarily because of subcommittee involvement with more pressing matters.

This year, the airlines feel CAB may face even greater delays because of congressional concentration on broad aviation issues.

Among major investigations which may hold congressional attention most of the year are continuing aviation safety studies by the Senate aviation subcommittee, along with consideration of Sen. A. S. Mike Monroney's (D.-Okla.) airport aid bill, guaranteed loan legislation for cargo aircraft and the possibility of subcommittee hearings on the wartime role of air traffic controllers.

In addition, the Senate Interstate and Foreign Commerce Committee is expected to spend considerable time on Chairman Warren D. Magnuson's (D.-Wash.) bill to create an Office of International Travel.

Tentative agenda of the House aviation subcommittee is expected to include lengthy hearings on airline maintenance, scheduling and service matters before any consideration of CAB's legislation program can be undertaken.

Major areas where the Board feels its authority should be expanded or clarified by legislative action are:

• **Board powers to set** clearly defined limits in route case consolidation proceedings should be further defined by legislative action. This is newly requested legislation which has resulted from a geographical overlapping of route cases. Because of the wording of present regulations, carriers often contest issues considered in consolidation orders on technical grounds filed in other separate cases, the Board says.

• **Existing right to inspect** the records of airlines should be expanded to cover service organizations controlled by air carriers. A repeat of a proposal suggested last year, this item failed to gain consideration before the Senate subcommittee. It could be accomplished by means of an amendment to Section 407 (e) of the Federal Aviation Act, the Board said, to clarify its powers to examine books and records. CAB contends that lack of access to such information hinders its ability to judge the accuracy of financial data presented during Board hearings and on common carrier pooling arrangements.

• **International air fares,** including both those of U. S. flag and foreign airlines, should be subject to CAB authority. Bills seeking this power were introduced in both the Senate and House last year, but did not reach a final vote. CAB has emphasized a particular need for this legislation to give the U. S. a better bargaining position in bilateral negotiations. Present lack of this power, the Board said, has put U. S. flag carriers in the position of being subject to almost complete rate control by the foreign countries to which they operate. Conversely, since foreign governments do assert authority over the rates of their own airlines, the Board says it is without power to prevent any foreign carrier from charging any fare or rate it chooses.

• **Complete control** over airline depreciation accounting procedures is claimed to be needed to give the Board a more uniform yardstick to accurately judge the financial condition of the airlines. Varying depreciation formulas now in use too often lead to mistakes which tend to accumulate over the years to a point where it is difficult for the Board to compare the actual financial status of the airlines, CAB said. This legislation was originally proposed two years ago after the airlines refused to comply with a Board order setting an across-the-board standard of seven years and a residual value of 15% for aircraft depreciation. The order was upheld by a U. S. District Court decision, but was later reversed on appeal by the carriers.

• **Increased authority** over ticket sales and reservations is needed to protect the public against the practice of ticket scalping. CAB pointed out that the practice of reselling tickets for a profit has grown in such market areas as New York-Florida and suggests a maximum fine of $5,000 be levied against any ticket or travel agent found guilty of this practice. Although considered by a Senate subcommittee last year, this proposal was not acted upon.

• **Subsidy and air mail rates** should be separated to eliminate the confusion which still exists in the public mind. Under this proposal, CAB has requested authority to abandon its present method of publishing a single mail rate which includes elements to cover both service mail pay and subsidy, in favor of setting and publishing a separate subsidy rate excluding the rates paid by the Post Office. Congress also failed to act upon this legislation last year.

• **Greater legal protection** should be afforded the Board by legislation permitting CAB to represent itself in court proceedings. Under existing laws, the Board is represented in court only by the Department of Justice. CAB has asked that it be allowed to join the Justice Department as an active participant in order to avoid "conflicts of opinion" which have arisen in the past. No action was taken on this proposal last year.

FAA Fines Lockheed For Electra Defects

Washington—Lockheed Aircraft Corp. has been fined $6,000 for delivering 18 Electra transports deemed unsafe for flight after airlines discovered debris inside the fuel tanks, missing bolts and wing skin cracking.

The Federal Aviation Agency fine covers 18 aircraft accepted by Eastern Air Lines, American Airlines and Western Air Lines over the past two years. However, 17 of the 18 Electra imperfections were uncovered during March and April, 1960.

An Eastern inspection of one Electra delivered last April disclosed that an industrial-type vacuum cleaner had been left in the wing fuel tank. A rivet gun, part of a paper cup and about 20 miscellaneous screws were recovered from a second Electra's fuel tank in the same month, Eastern reported.

According to Western, an Electra inspected last April had wing skin cracks ranging in length from 4.5 to 33 in. Earlier, in October, 1959, Western said that trash was extracted from another Electra's internal wing area after Lockheed had installed reinforcing bands near the same spot.

After inspecting 34 Electras last spring, American told FAA that 14 of the transports were fitted with bolts without nuts or poorly sized bolts that in some instances had loosened in their tracks.

A maximum fine of $17,000 could have been levied, but FAA accepted the compromise penalty after the manufacturer instituted a quality control program aimed at preventing any recurrence of the defects.

Since the original carrier complaints, FAA told AVIATION WEEK, no significant violations have been reported either by the airlines or by the agency's field inspectors.

Lockheed's quality control measures involve restricting the number of personnel authorized to enter Electra wing fuel tanks, training special mechanics to service internal wing areas and keeping an inventory of all tools and articles carried into the wing of each aircraft by those authorized to enter them.

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FM10 Miniature, non-floated, two-axis free gyro with synchro pickoffs and torquers on both gimbal axes.

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For complete information and specifications, write for Data File AW-1162-3.

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PACIFIC DIVISION

Railroads Propose Commission In New Drive for Airline User Fee

Washington—Drive for the creation of a federal National User Charge Commission will key the railroad industry's campaign against direct and indirect government support of competing forms of domestic transportation.

In one of the most intensive public relations programs in railroad history, the industry will urge Congress to establish the commission to estimate, every three years, the approximate full cost of airways and airport operations, inland waterway improvements and federally assisted highways, then determine the kind and amount of fees that should be charged against the users.

Motor carriers will be the chief target of the campaign, which generally will follow patterns set by the railroads in previous years, but the drive against the airline industry will be substantially accelerated.

In addition to demands for user charges, the railroads will continue their fight to actively enter other fields of transportation. The railroads contend that motor and water carriers are entitled to control other forms of surface transportation and that air carriers may engage in any mode of transportation, surface or air, but that railroads are "usually" restricted to service by rail.

The rail carriers contend that such diversification would eliminate duplicate facilities, create improved services and lower costs of these services. Airlines have argued that air and surface transportation systems are entirely different, both technically and operationally, and thus would be incompatible under one management.

Railroads charge that $162 billion in federal funds has been spent in the U. S. on highways, airports, airways and inland waterways. They add that, since this is a figure five times greater than the entire investment of private funds in the railroad industry, their competitors have an "artificial" price advantage over the railroads.

In their campaign, the railroads will admit that each form of transportation has its own advantage to offer shippers, but they will claim that pricing is a major factor in deciding which carrier to use—air, water, highway or rail. In this connection, the railroads will ask: "How can a privately-owned business match competitors who are subsidized in varying measure by the government?"

Railroads will point out that airlines have received direct federal air mail subsidy since 1939 of $581 million, pointing out that in the past 10 years, railroad passenger deficits totaled $6 billion.

They plan to quote the cost of maintaining and operating the federal airways system between 1925 and 1960 at $2.4 billion and then emphasize that the existing two cents per gallon tax on aviation gasoline currently yields only $20 million a year.

The railroads will describe their suggestion of the establishment of a National User Charge Commission as a "start" and will propose a formula for setting the user charges according to the type of user and the number of users. They will ask that the amounts charged adequately offset the estimated costs of the facilities provided by the government.

Under the proposed plan, state and local government-owned roads, waterways and airports would not fall under the jurisdiction of the commission but nevertheless, the railroads have urged that local user charges be assessed. Railroads will suggest that state and local governments take advantage of the estimated costs of transportation facilities developed by the commission as a guide in establishing their own user charges.

The rail industry has concluded that current government policies have made it possible for its competitors to use facilities "built and maintained at taxpayers' expense" without any reimbursement or an "insufficient" reimbursement to the government "for their fair share of the cost." They say that such a policy has "weakened the railroads financially, which in turn has brought about such secondary effects as deferred maintenance, furloughing of valued veteran employes, and reduction of the railroads' capabilities in the event of war."

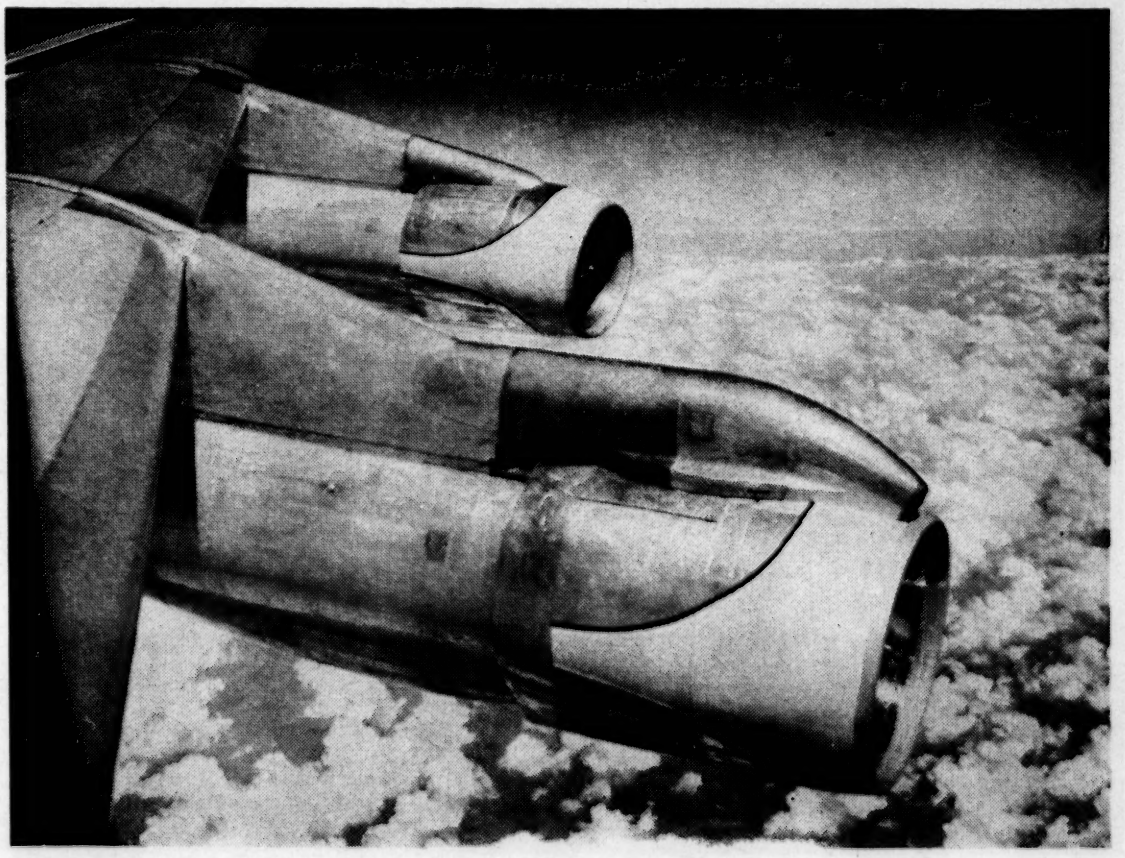
American Prepares For Turbofan Flights

New York—American Airlines expects its first turbofan-powered jets to be certificated by late this month and to have the first units in scheduled service Mar. 12.

Turbofan schedules set for that date include American's first jet service between Chicago and Mexico, and services between New York and Los Angeles and between New York and Chicago. The New York-Los Angeles route will be served by Boeing 707-120B converted aircraft, while the other two runs will be served by Boeing 720B turbofans off the production line. American expects to have half a dozen of the two types of turbofan planes by the Mar. 12 date.

The Chicago-Mexico service will be daily, and will connect with a New York-Chicago flight.

American expects its jet fleet to be all-turbofan by the end of this year (AW Feb. 6, p. 36). The airline says the Boeing turbofans will cruise well in excess of 600 mph. and fuel savings with the engines are estimated at up to 20% over present equipment. The turbofan Convair 990, which American is to receive later this year, cruises at 640 mph., according to the airline.



TURBOFAN ENGINES on American Airlines' Boeing 707-120B transcontinental-range transport are Pratt & Whitney JT3D-1s, rated at 17,000 lb. static takeoff thrust.

Air France Public Relations personnel stand ready to serve you in New York, Chicago, Los Angeles, Montreal, Mexico City.

SAS $17 Million Loss Tied to Jet Transition

Stockholm – Scandinavian Airlines System reports an over-all loss of some $16.8 million for its last fiscal year of operation up to Sept. 30, 1960, although over-all gross revenue for the same period went up by roughly $19.6 million to about $130 million.

Announcement was made at an SAS board of directors' meeting held here recently, at which details of the company's annual report and balance sheet were reviewed.

The deficit is attributed chiefly to the cost involved in switching from piston-engine to turbojet aircraft, to extra depreciation of the carrier's Douglas DC-7 fleet because of its current lower market value and to the necessity to create reserves to cover any risk involved in the airline's overseas investments.

These include securing a share in the traffic to Mexico and Siam previously not served by SAS, by cooperating with Guest Aerovias Mexico, S.A. and Thai Airways Company, Ltd., in agreement with which SAS established a new company, Thai Airways International, Ltd.

In addition to about $40 million spent on new hangars, workshops and related facilities for its jet transports, SAS has had to invest approximately $120 million in the purchase of its fleet of medium-range Sud Aviation Caravelles and long-range Douglas DC-8 jet aircraft.

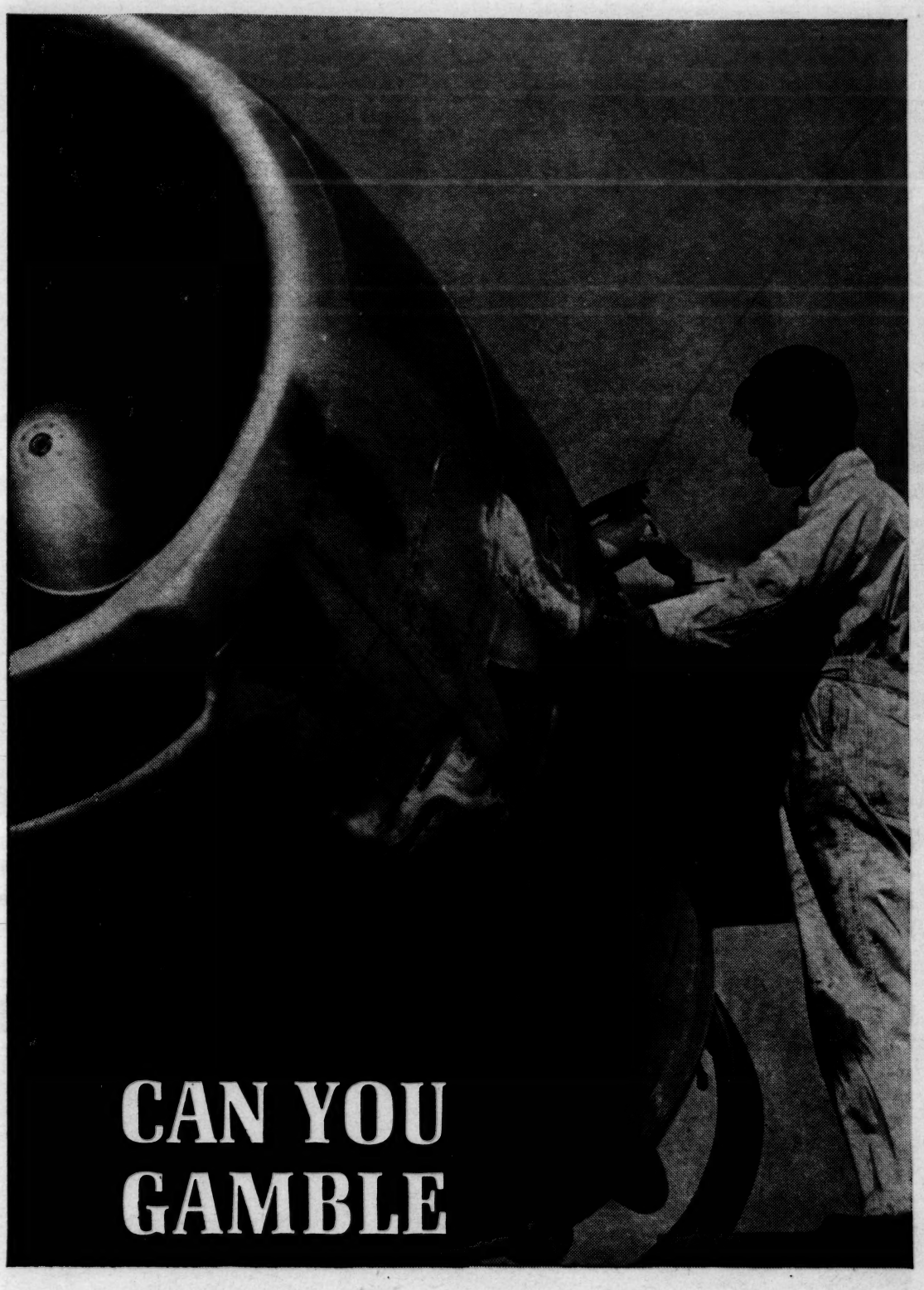
Another factor contributing considerably to last year's loss, according to SAS, was the necessity of having to operate a large number of different types of aircraft during the jet transition period, which resulted in much higher maintenance costs.

The airline's continuing changeover to jet services is expected to result in another loss by the end of the current fiscal year, but by 1962, SAS says, its estimates indicate an improvement.

New Charter Carrier Organized by Swiss

Geneva—Globe Air Limited, a new Swiss air charter company with capital of approximately $250,000 has been established at Basle, and last month obtained Federal Swiss Air Office approval to operate its planned non-scheduled domestic and foreign services out of Basle-Muhlhausen airport where it is based.

Globe Air will initially use two de Havilland Elizabethan type 49-seat transport aircraft recently acquired from British European Airways, one of which is already in service.



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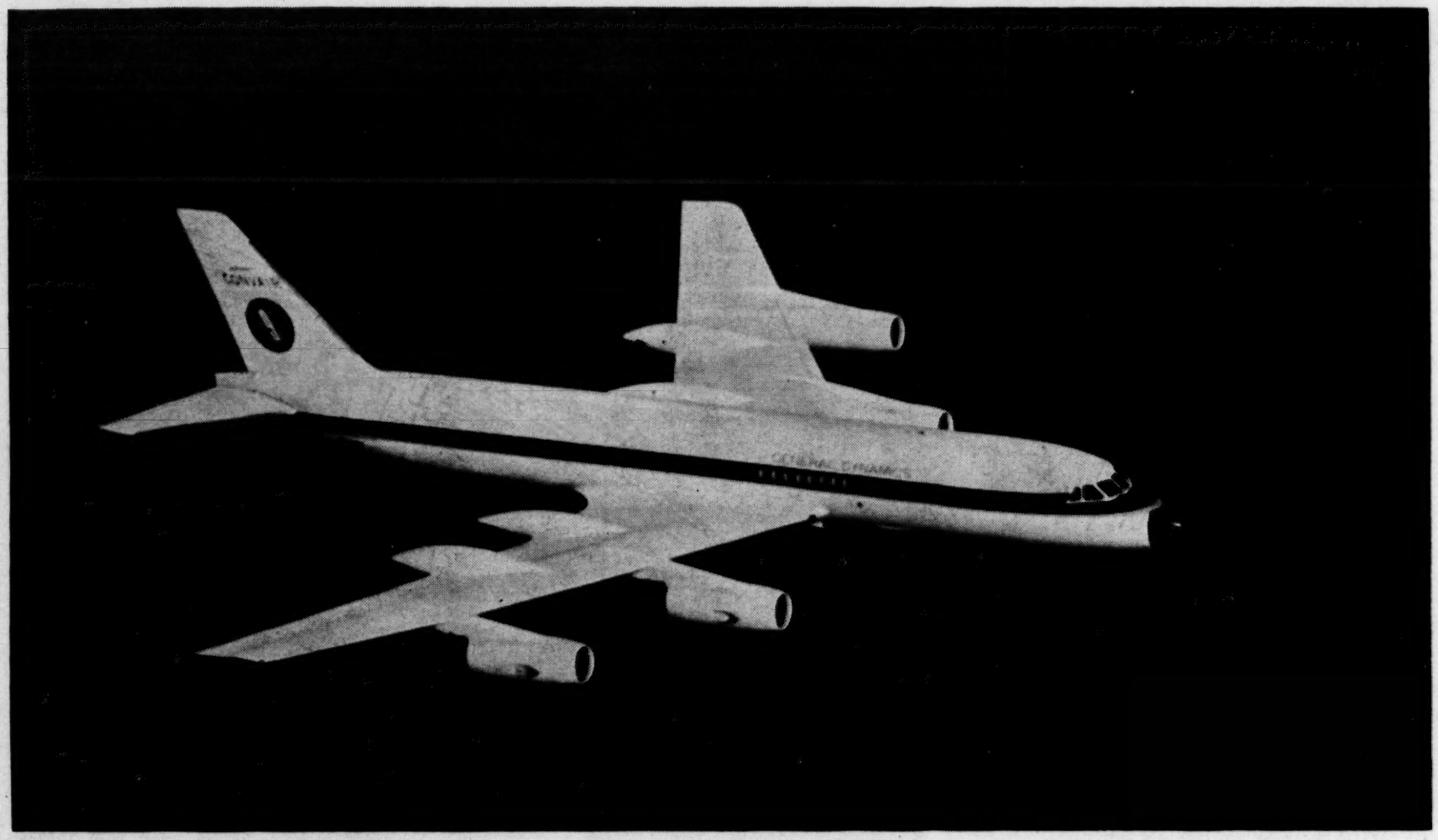
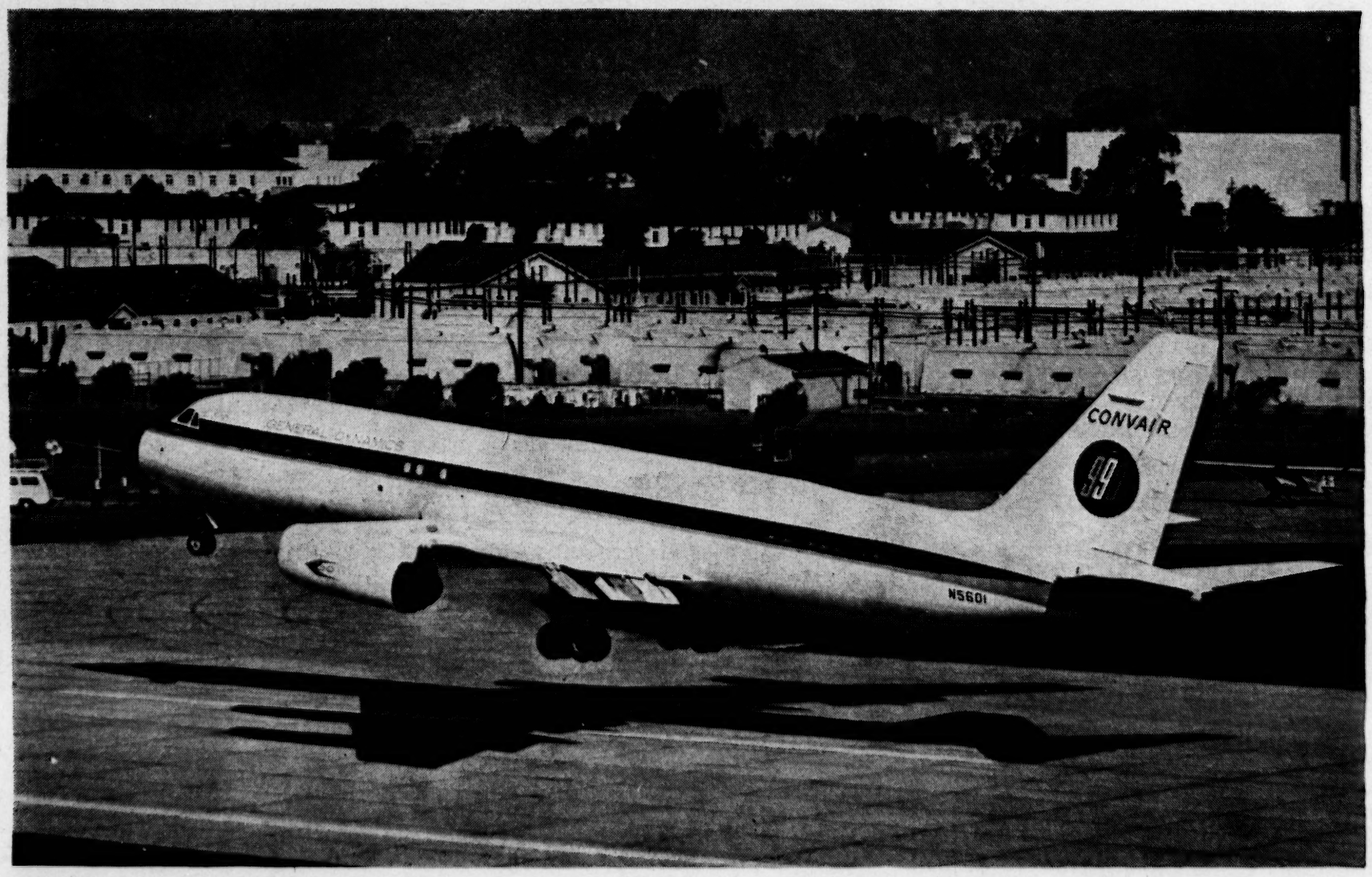


Convair 990, after 12 hr. of flight testing, is being prepared for intensive ground taxiing tests to determine optimum adjustments on thrust reversers. Note speed capsules, flat-bottomed to avoid interference with lower wing surface, on the upper portion of the wings extending aft of the trailing edges (AW Dec. 5, p. 43). Wing sweepback at the leading edge is 39 deg. Leading edge slats, extended at the same time as the trailing edge flaps, postpone airflow separation to higher angles of attack, permitting nose-high take offs and landings.

Convair 990 Has Completed 12 hr. of Flight Tests



Aircraft is shown taking off at San Diego. The transport is configured to carry 96 first-class passengers in four-abreast seating or 121 coach passengers in a five-abreast arrangement. Convair 990 is powered by General Electric CJ805-23 turbofan engines, each rated at 16,100 lb. thrust (AW Jan. 30, p. 39). Basic 990 carries 15,100 gal. of fuel. The speed capsules also are used for fuel storage.

FAA Will Take Over Military Flight Service

Washington—Functions of Military Flight Service will be absorbed by Federal Aviation Agency Feb. 15 as part of Project Friendship, a program to eliminate duplication between FAA and Department of Defense.

The consolidation, under which all six Military Flight Service Centers of Military Air Transport Service will be deactivated, gives FAA responsibility for:

- **Transmitting flight plans** of Air Force, Navy, Army and Marine Corps pilots from filing point to destination airport.
- **Relaying to en route** pilots advisories on weather, airport hazards and new NOTAMs (notices to airmen) affecting the safety of their flights.
- **Instituting communications** searches for overdue aircraft or direction-finder service for pilots unsure of position.
- **Filing incident reports,** alleged violation reports or miscellaneous operational messages of military pilots.

Involving 180 of FAA's 414 Flight Service Stations, the shift will free about 500 USAF personnel in Airways and Air Communications Service (AACS) for other assignments. Air Force also expects to save about $2 million annually after the task of transmitting 4-6 million flight service messages per year is taken over by FAA.

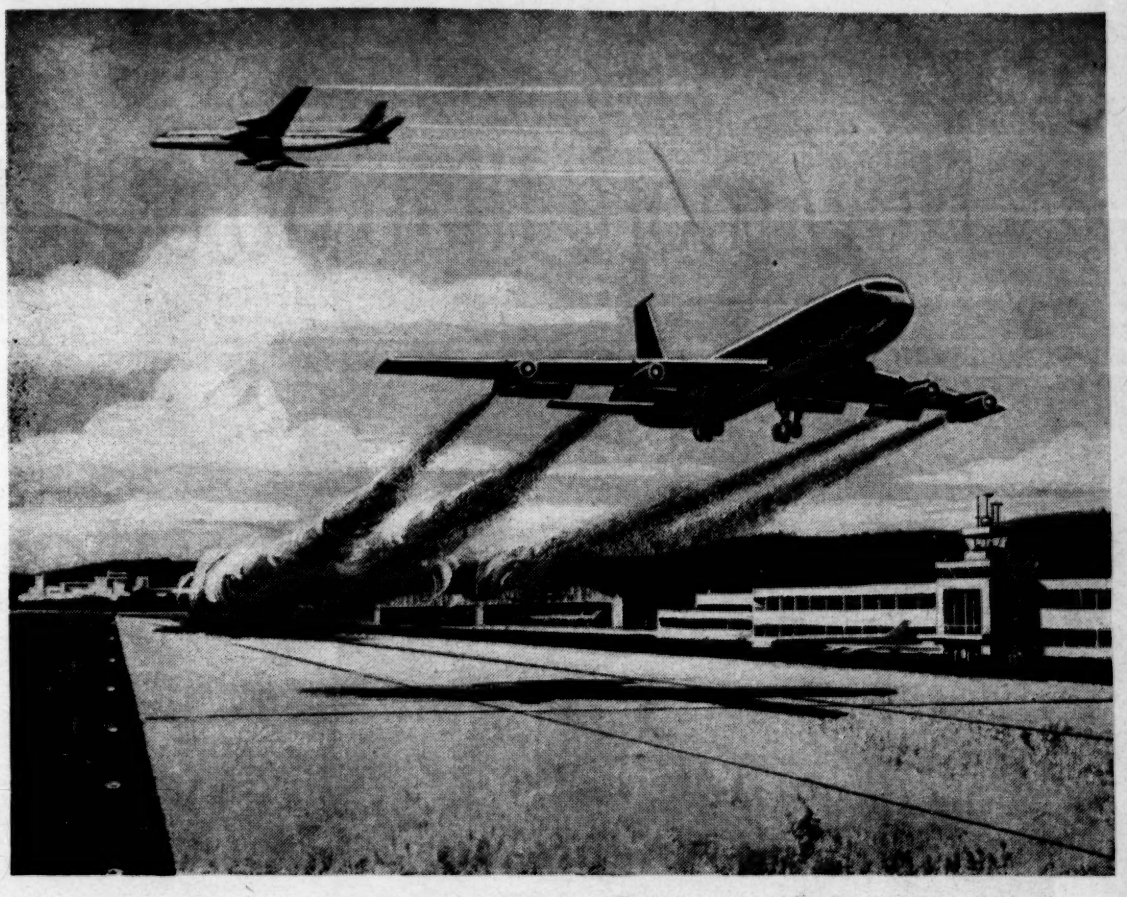
To fill in functional gaps created by the consolidation, the military services have retained responsibility for approving their pilots' flight plans and for furnishing weather briefings. Air Force, however, has adopted the Navy policy of delegating clearance authority to all pilots departing stations without a military operations officer.

Project Friendship is a three-part program aimed at paring DOD expenditures on military controller training, in-flight inspection of military air navigational aids and flight service. It was launched by FAA in September, 1959.

Canadair Increases CL-44 Range, Speed

Canadair has announced range and speed improvements over the original performance guarantee of its turboprop CL-44 swing-tail freighter.

According to the manufacturer, the aircraft's range increase is 6% or 320 mi. over the guarantee, and the speed increase is 3½% or 13 mph. Canadair recently announced an 11 to 12% reduction in runway requirements for the CL-44, now set at 6,800 ft. for maximum takeoff weight and 5,980 ft. for maximum landing weight.



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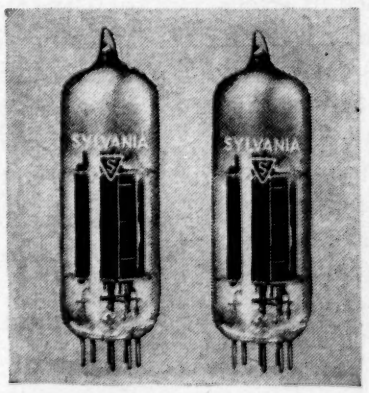

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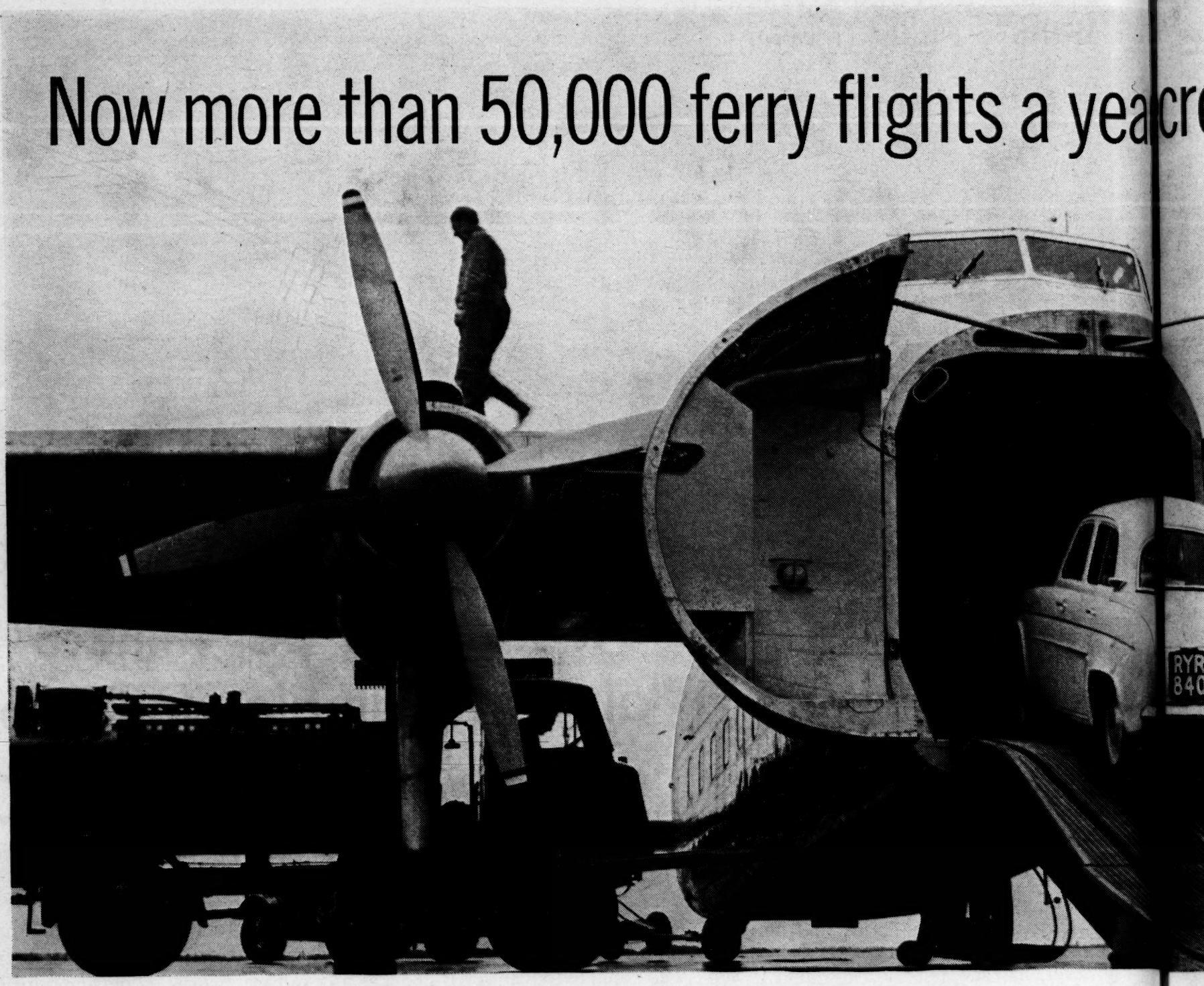

...AND BRISTOL SIDDELEY

In only 12 years, a revolution has taken place in transportation across the English Channel. Today, a large share of the total cross-channel ferry traffic is carried by two vigorous, independent British airlines. Silver City Airways, who pioneered these services, and Channel Air Bridge, a British United Airways company, run scheduled services for cars and their passengers and general freight with greater frequency and efficiency than many bus companies. For in the year ending September 1960 alone, they carried a total of 206,121 tons (including 117,674 cars) on 54,443 flights across the North Sea and English Channel. On these routes both companies exclusively use Bristol Freighter aircraft, powered by Bristol Siddeley Hercules engines.

Bristol Siddeley engines—hard working, hard earning The Hercules is just one example of a long line of Bristol Siddeley engines designed and built for hard-working, hard-earning and trouble-free civil operation. These same qualities have been manifested in powerplants over the years, ranging from sleeve-valve engines of up to 2,850 hp to turboprops up to 4,400 hp, and turbojets up to 20,000-lb thrust.

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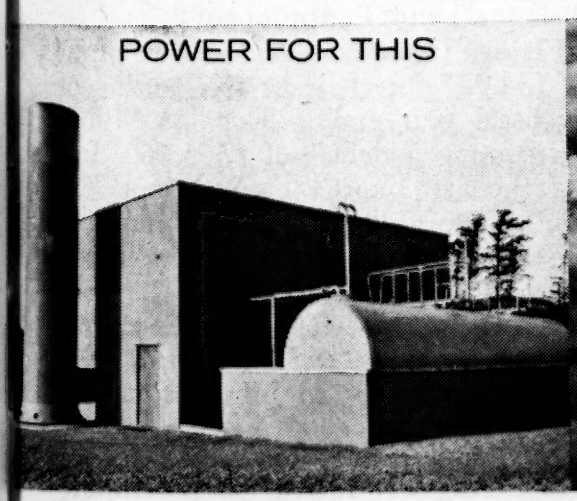
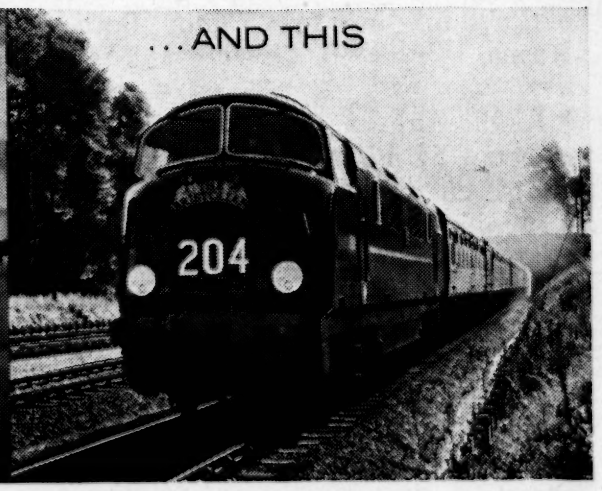


The Bristol Siddeley Industrial Proteus gas turbine engine powers a 3-megawatt turbo-generator. Designed for peak-lopping and stand-by generation, this new pocket power station, two of which are in service, delivers full power within 2 minutes of a cold start for a lower capital cost than any other type of installation.

The Bristol Siddeley Proteus turbo-prop powers the Britannia airliner in service with 12 airlines and RAF Transport Command. The Proteus which has now logged over 1½ million flying hours, is famous for its reliability, for it reached the exceptional overhaul life of 2,400 hours more rapidly than any other aero-engine.



Bristol Siddeley Maybach diesel engines power Britain's crack express train—the British Railways "Bristolian". Two Type MD 650 engines, developing a total 2,200 hp, give the "Bristolian" a top speed of over 90 mph. 286 Bristol Siddeley Maybach diesels have been ordered by British Railways alone.

AIRLINE OBSERVER

► Airlines are waiting for invitations to bid on long-term airlift contracts as a result of President Kennedy's announcement that military dependents overseas need not return home. Military Air Transport Service recalled its earliest request for contract airlift proposals from the industry after President Eisenhower, in an effort to halt the drain on U. S. gold reserves, ordered the families home last fall. Since then, contract airlift awards have been parceled out to U. S. carriers on a month-to-month basis.

► Watch for new provisions tightening over-water training requirements for Air Force Reserve navigators who would fly Civil Reserve Air Fleet (CRAF) transports during national emergencies. General Aviation Division of the Department of Commerce is considering a program under which navigators now training on Fairchild C-119 troop carrier transports would fly long-range practice missions on overseas airline flights. At the same time, pilots working for domestic airlines linked to CRAF would receive courses in ditching and the differences between domestic and international sections of the Civil Air Regulations.

► Hawaiian Airlines has reduced its management staff by a total of five officials, including a vice president, as result of its decision to retire from transpacific charter operations. With the exception of a weekly flight between Los Angeles and Kwajalein Atoll under contract with Western Electric Co., Hawaiian will no longer be active in the contract business.

► Eastern Air Lines and Trans World Airlines have become the first U. S. carriers to crack the 1,500-hr. time between overhaul (TBO) barrier on Curtiss-Wright TC18 series Turbo Compound engines (AW Dec. 12, p. 47). By holding their TC18 failure rates below 0.4 per 1,000 engine hours for a full quarter, the two airlines won 100-hr. TBO increments from the Federal Aviation Agency and are now overhauling their Douglas DC-7 and Lockheed Super Constellation powerplants at the 1,600-hr. mark.

► New York International Airport (Idlewild) is experimenting with a device to alleviate the bird problem which will trigger a series of reports similar to gunshots. Called "scare-away," the system uses tanks of compressed gas which are ignited every minute and a half. The airport now has 12 units and, since results appear successful so far, several dozen more may be purchased. If the experiment is successful, the question will arise as to who will be responsible for permanent installation—the airport operator or Federal Aviation Agency. Other airports, including Boston's Logan International, are testing similar devices.

► Soviet-built An-10 turboprop transport will begin regular service this month on Aeroflot's route from Moscow to Norilsk via Syktyvkar. The aircraft recently made a training flight between Norilsk and Syktyvkar—a distance of 2,490 mi.—in 6 hr. 25 min. Both cities are in the far northern section of Russia.

► Riddle Airlines predicts that 1961 gross revenues will better the 1960 level of about $7 million by at least 400%. Operating seven Douglas DC-7CFs and seven AW 650 Argosy freighters, the carrier expects gross business of $33 million this year, with a $3 million profit. Advance orders for transatlantic charter flights already exceed $2 million, and President Robert Hewitt estimates that more than $4 million in bookings will be received before the season opens June 1.

► Eastern Air Lines now has a competitive advantage over Air France on the New York-Mexico City route. Originally, Eastern was confined to first-class configuration on all flights on the route while Air France was able to operate piston equipment in mixed configuration. Since Jan. 16, Air France has been operating four Boeing 707-320 turbojet flights weekly, the limit allowed under the French-Mexican bilateral agreement. Eastern's recent agreement with Aeronaves de Mexico now permits Eastern to operate five flights weekly on the route using its Douglas DC-8 jets in mixed configuration.

SHORTLINES

► **Air-India International** is operating weekly Boeing 707 intercontinental service between Bombay and Tokyo via Calcutta, Bangkok and Hong Kong. The Indian carrier says the service reduces flying time between India and Japan to 12 hr. 55 min.

► **Alaska Airlines** reports it carried 127,621 passengers during 1960, compared with 116,010 flown in 1959, and it increased revenue passenger miles from 91,058,000 in 1959 to 108,459,000 last year. Total revenue ton-miles rose from 13,755,627 in 1959 to 16,107,751 in 1960, with over-all revenue load factor rising from 56.1% the previous year to 63.4% in 1960.

► **Allegheny Airlines** carried 680,986 passengers 131,650,000 revenue passenger miles during 1960, increases of 18% and 33% respectively over 1959. Total revenue cargo carried in 1960, including air mail, first class mail, express, freight and excess baggage, rose 37% over 1959 to 13,788,734 lb.

► **British European Airways** reports traffic increased 20% to more than 3.8 million passengers during 1960. The British carrier estimates its profit for 1960 will be $4.2 million and attributed most of the 1960 growth to fare reductions and introduction of de Havilland Comet 4B turbojet transports during the year.

► **Ethiopian Airlines** carried 104,067 passengers on scheduled flights during 1960 and flew a total of 65,338,000 passenger miles, a 17% increase over 1959. The airline, which receives management assistance from Trans World Airlines, increased its mail volume 22%, but had a decrease of 5% in air freight traffic.

► **Flying Tiger Line** had a net profit of $34,927 for the first six months of its fiscal year ending Dec. 31, 1960, overcoming a deficit of $566,460 during the first quarter ending Sept. 30, 1960. The airline attributed much of the increase in income to improved conditions in the government contract field. Revenues for the six-month period were $14,118,344, up from the $13,698,240 recorded in the comparable 1959 period.

► **Los Angeles International Airport** rental rates for airline facilities will pay the city of Los Angeles more than $23 million in 10 years. Agreement has been reached with airlines using the airport on 28-year lease pacts covering interest and depreciation on the city's capital investment.

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When you think of Canada, think of

TRANS-CANADA AIR LINES (TCA) **AIR CANADA**

GRUMMAN orbiting astronomical observatory is seen in artist's impression. Paddles at side contain solar cell array; sunshade points toward the observer. Astronomical experimental package is carried in cylindrical shell.

Grumman's Orbiting Observatory Design P

By David A. Anderton

Bethpage, N. Y.—Orbiting astronomical observatory (OAO) contract is Grumman Aircraft Engineering Corp.'s first return on its $10-million investment in space futures.

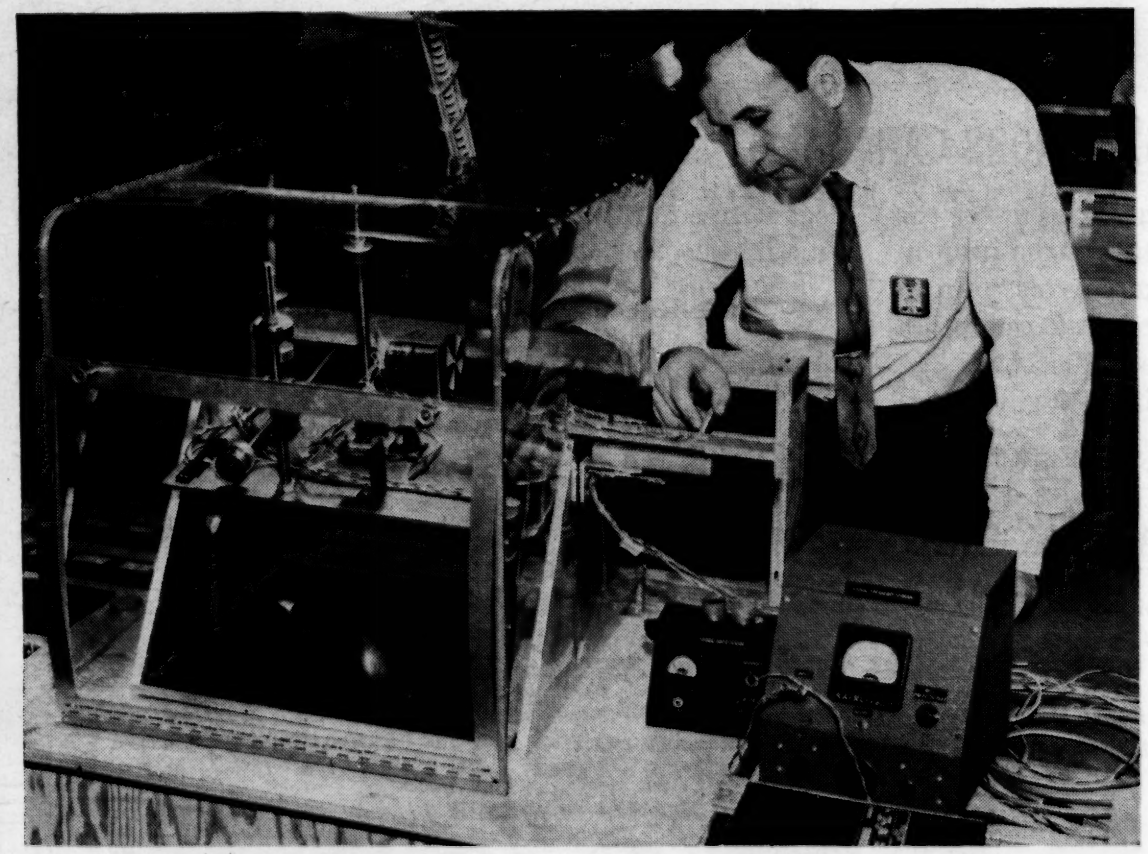
The company's entrance fee to the space competition is represented largely by technological facilities which were designed by Grumman engineers to meet the unusual problems posed in the hostile environment of space.

These buildings and their equipment were planned to increase company capabilities in space technology by providing development facilities for basic engineering work or test and simulation facilities for designs in more-advanced stages.

Supported by these in-house laboratories and encouraged by the strong showing of earlier proposals in the Mercury and Apollo competitions, Grumman is driving hard to win selected competitions for space vehicles and systems.

The OAO contract was the first tangible result of the effort (AW Oct. 17, p. 30).

Initial contract awarded by National Aeronautics and Space Administration is for $23 million, with final project cost estimated at $100 million. Grumman is prime contractor and systems manager for the OAO and its ground-support equipment.



TYPICAL of special devices used in OAO development is this single-axis simulator designed by Grumman avionics engineers. Unit is rigged to check out functional operation of momentum-transfer system for OAO orientation.

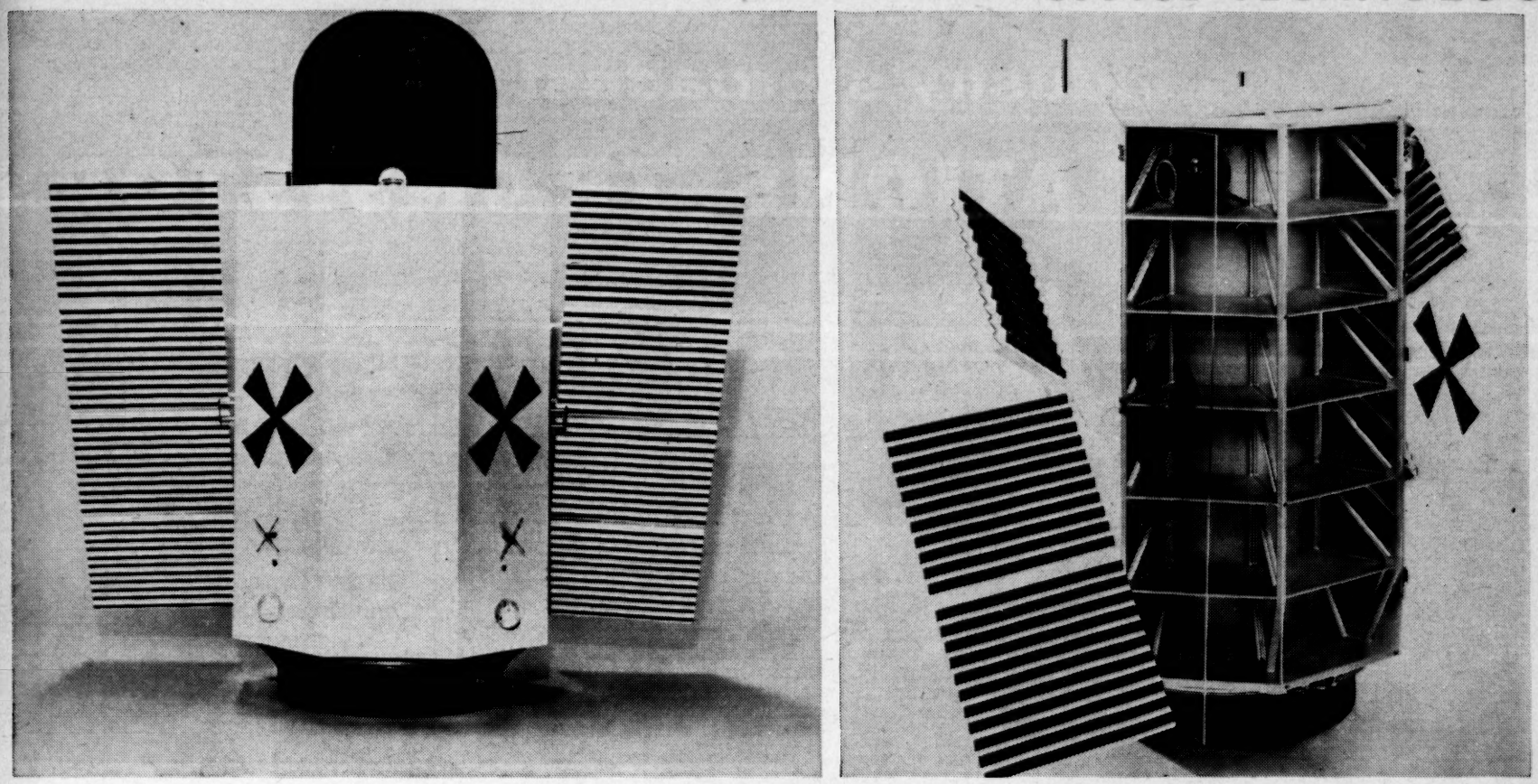
OAO Concept

Under the NASA contract, Grumman is to design, build and deliver two observatories which can be used to house equipment for a variety of astronomical experiments. Current experiments planned for the OAO include at least five that would each demand a spacecraft; contract extensions are expected to cover the construction of an additional number to match those needs.

The OAO is designed to the spacecraft concept: the use of a single versatile vehicle to carry a variety of experimental equipment.

Basic requirements for the OAO were developed in early discussions by a group of astronomers and NASA and were presented to industry in a briefing Dec. 1, 1959.

The requirements delineated a spacecraft with payload and volume to handle an astronomical telescope—or equivalent experimental apparatus—with a 36- to 40-in. aperture. The control system had to be able to point the telescope within



OAO MODEL shows saw-toothed solar cell array on extensible paddles. Sunshade is at top of the octagonal shell. Turnstile antennas are on alternate side panels and top of spacecraft. Hemispherical domes are star trackers; smaller holes above them house sun trackers.

n Progresses

an accuracy of a fraction of a second of arc, and to hold that line of sight for 45 to 60 min.

Astronomers specified a circular orbit at a height of about 500 mi. Lower altitudes would produce too much air drag, and higher altitudes would demand shielding of the observatory.

To these general specifications were added these detailed considerations:

- **Remote control** by an observer on the ground.
- **Automatic observation** and collection of data.
- **Automatic or command** transmission of stored data.
- **No possibility** of any maintenance.
- **Symmetry of weight,** inertias and surfaces within ½%.

Finally, practical restrictions were set on the design by the availability of a launching vehicle. Originally planned to be NASA's Vega space booster, under development by Convair, the OAO carrier will be the Atlas-Agena B as a result of cancellation of the Vega program.

Grumman Design

Designers in Grumman's Space Sciences group came up with a simple layout for the OAO which belies the technical difficulties posed by the requirements.

They developed an octagonal container with a hollow central cylindrical shaft; the shaft dimensions—44-in. dia. x 112-in. long—include provisions for mounting the 40-in. dia. x 112-in. long experimental package.

The octagonal body measures 80 in.

SINGLE AIR-BEARING table is used as three-axis simulator to test control equipment for the Grumman OAO. Ball bearing is ground to 50 millionths of an inch sphericity, has a surface fineness of five millionths of an inch. Air bearing can support 1,000-lb. gross weight, is sensitive to stray convection currents caused by two 60-watt lamps in the room.

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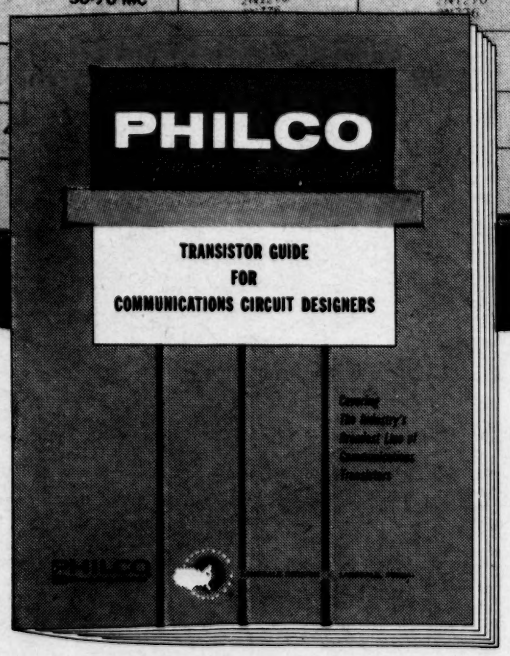

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OAO Program Timetable

Feb. 1959:	First meeting of astronomers to discuss potential experiments.
Aug. 1959:	NASA sends preliminary specifications to industry.
Dec. 1, 1959:	NASA gives industry briefing on OAO.
May 1960:	NASA requests OAO proposals from industry.
July 5, 1960:	Date for final submission of OAO proposals.
Oct. 10, 1960:	Grumman wins OAO competition.
Dec. 1, 1960:	NASA-Grumman contract negotiation completed.
April 1963:	Scheduled first delivery of OAO.
Late 1963:	First launching of OAO from Cape Canaveral.

across the flats and is 118-in. long.

Solar cells on four extensible paddles will provide the power supply once the OAO is stabilized in orbit. These paddles mount a total of 63.5 sq. ft. of cells, held in a saw-toothed arrangement, which positions each cell at 22½ deg. to the plane of the paddle. The planes of each paddle make an intersection angle of 33.75 deg. with the centerline of the spacecraft.

Arrays of turnstile antennas, sun trackers and star trackers dot the exterior shell of the OAO.

An external sunshade to keep the observing equipment in shadow during operation completes the physical layout of the OAO. Sunshade and solar-cell paddles are retracted during the launch and extend permanently once the station is in orbit.

Primary Structure

Primary structure of the OAO is its central cylindrical shell which houses the experimental packages. This shell gives torsional stiffness to the spacecraft and provides shear continuity across it. It is formed conventionally of 7075-T6 aluminum alloy sheet, and is 44 in. in diameter and 112 in. long.

Eight truss beams, attached radially to the cylinder, divide the space between the cylinder and the external skin into eight bays of trapezoidal cross-section. The eight beams transfer axial loads on the spacecraft into a base ring structure, which also is the separation plane between the OAO and its Agena B carrier.

Five sets of structural shelves, spaced equidistant along the optical axis of the spacecraft, further divide the interior space into compartments to carry internal equipment.

Two of these octangular doughnuts will be available as compartments for experimental equipment, and portions of two others may be used. The remainder of the internal space is taken up by control, data-handling and communications equipment.

External skin consists of eight side panels each about 33 in. x 116 in., and two octagonal end plates about 80 in. across the flats. There is no direct thermal contact between the skin panels and the internal structure; instead, the skins are hung on ceramic insulators which are fastened to the truss beams, and the skin panels are also latched together for rigidity.

The skin also functions as radiation shielding, micrometeorite bumper and a radiator for the heat generated by internal equipment.

Heat Transfer Control

One of Grumman's major design problems in developing the OAO is to control the thermal environment of the OAO. There will be heat inputs from the internal electronic equipment and from the sun and the earth's radiation —both direct and reflected. There will be thermal gradients from the cool experimental package and from the spacecraft areas away from the sun. There will be transient heating as the OAO enters and leaves the earth's shadow, and as electrical power is generated by the solar cells intermittently.

Grumman's basic approach is to insulate the experimental package from the rest of the OAO and—by using insulation, shielding, conduction paths and the proper materials—develop a passive system that is reliable and consumes no power.

The skin panels, by being suspended clear of the structure, minimize the thermal gradient because there is no direct thermal path between interior structure and external skin. The external skin is coated with a flame-sprayed aluminum oxide which has high reflectivity.

Low conductivity material separates the avionic equipments from the structure, and radiation shields prevent radiant heat transfer from the equipment to the experimental package.

Heat is transferred by radiation from the electronic packages outward to the external skin, with the amount of transfer adjusted by carefully designing the amount of skin area which is "seen" by the avionic equipment.

Maximum temperature spread through the spacecraft will be about 140C, ranging from the —100C minimum equilibrium temperature of the experimental package to the 42C maximum temperature of the outer skin.

Control system of the OAO is intended to stabilize and point the observatory, ready for its first experiment,

QUALITY
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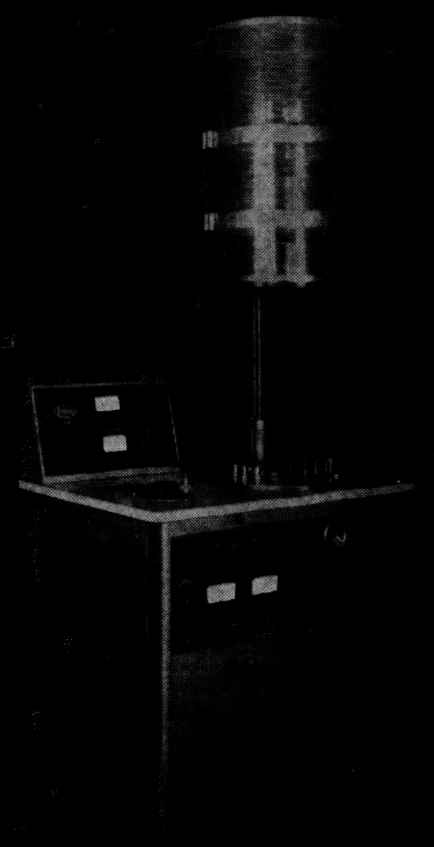

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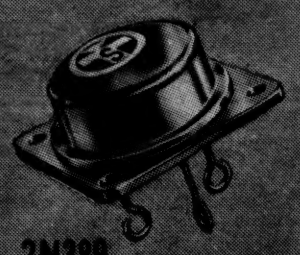

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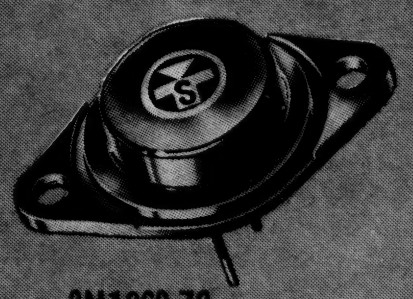

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40 Watts

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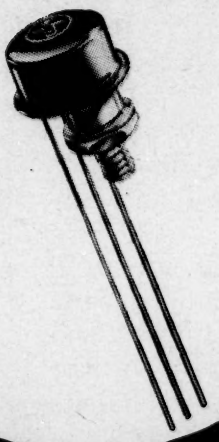

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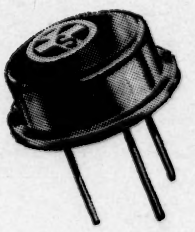

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Orbiting Observatory

Observations of interstellar matter, whose distance from earth is measured in light years, are very difficult for two reasons: the faint light emitted, and the small size—angularly—of the objects.

The earth's atmosphere acts as a barrier to accurate observations of even such nearby objects as the moon for two reasons: distortion of the light from the bodies, and the selective absorption of characteristic radiations that help identify stellar objects.

One obvious way of improving astronomical observations is to escape the detrimental influence of the earth's atmosphere with an orbiting observatory. But an additional requirement is imposed by the desired resolution—the sharpness with which distant objects can be seen—available even above the atmosphere. The orbiting optical equipment must have better resolution than the best offered by ground-based equipment.

Many astronomers consider the ideal minimum to be a 50-in. aperture telescope in a 24-hr. orbit. But for practical reasons and to match predictable technological advances, particularly in launching vehicle design, the scientists are more than willing to settle for a spacecraft with the advanced capabilities and versatility of the Grumman OAO.

within five hours after it reaches orbit. First task of the system is to stabilize the spacecraft after booster separation, where it will have a random angular orientation with respect to inertial space, and an assumed angular rate not more than one degree per second around any axis.

After stabilizing the vehicle, the control system must then be able to point the OAO to meet the requirements of specific experiments and then hold the point to the necessary accuracy.

Stable Attitude

Five stages of control-system operation take the OAO from its initial conditions after Agena B separation to a stable attitude:

• **Initial rate stabilization,** sensed by three rate gyros which provide control signals to reduce tumbling rate to zero.

• **Initial solar orientation** uses a system of six solar sensors which produce error signals to drive the OAO so that its optical axis points away from the sun.

• **Initial roll orientation** controlled by a set of six star trackers. The OAO rolls about the optical axis and each of the trackers locks on to a pre-selected star. Redundancy in the system improves accuracy by statistical analysis of the readings.

• **Initial star pattern verification,** done by comparison between observed and stored data.

• **Orientation,** which depends on a momentum-transfer system using three sets of inertia wheels. Each set has a larger wheel for coarse control and a smaller wheel for fine control. Coarse control will point the OAO within an accuracy of one minute of arc and hold the drift below 15 sec. of arc in 50 min. Fine control will point with an accuracy of 0.1 sec. of arc, with a drift rate of 0.1 sec. of arc per second. This corresponds dimensionally to a movement of 0.0001 in. of a point on the outer surface of the OAO.

Grumman's particular capabilities in manufacturing techniques, plus its long-term background as a developer of aircraft, enable the company to carry a large share of the OAO project in its own house. But some of the specialist areas in communication, data systems, stability and control systems will be filled with the help of subcontractors.

Primarily, the data processing equipment in the OAO stores commands, interprets and distributes these commands, gathers data for experiments and control of the spacecraft, selects observed data for transmission, and stores it until it can be transmitted.

Data processing is a digital system, and any analog inputs are converted to digital for storage and transmission.

Communications system includes four

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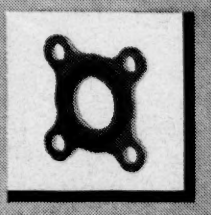

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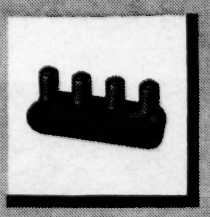

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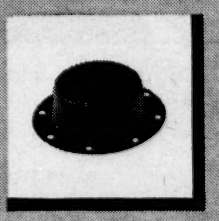

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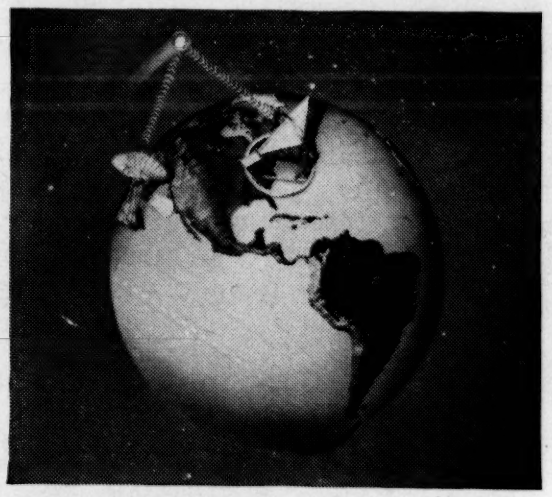
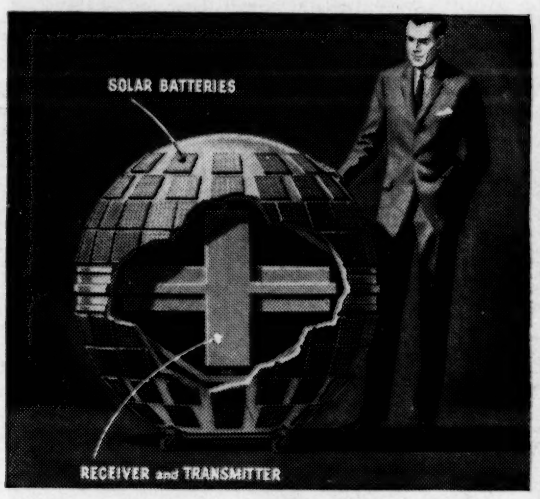
Where was the Bell Telephone System

ON FRIDAY, AUGUST 12, 1960?

It was handling some 210,000,000 local and long distance conversations, plus about 5000 overseas calls.

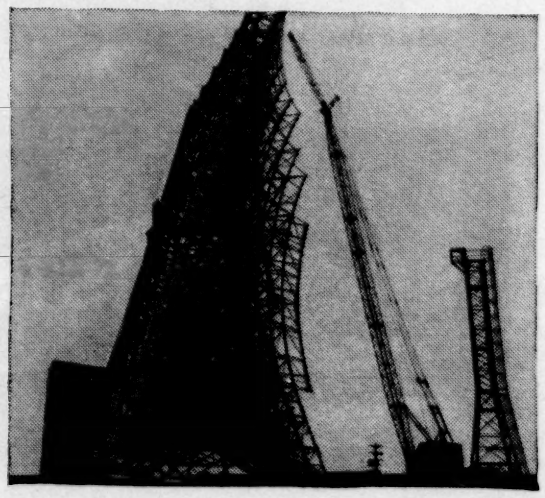


It was guiding Echo I into near-perfect orbit so Bell System scientists could make the world's first telephone call via satellite.



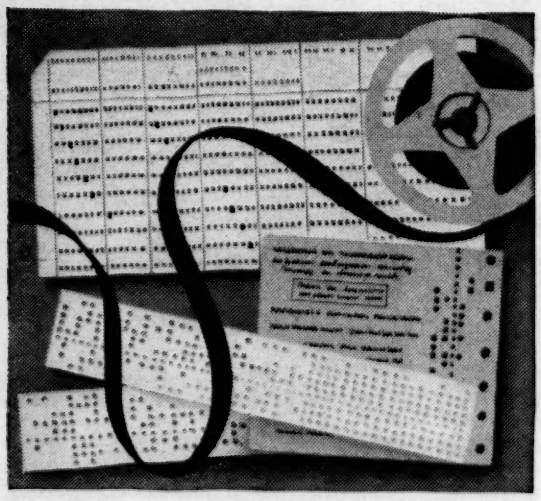
It was developing a world-wide communications system using satellites powered by the Solar Battery, a Bell System invention.

It was offering Bellboy personal signaling to more and more people. Device uses tiny Transistors, another Bell System invention.

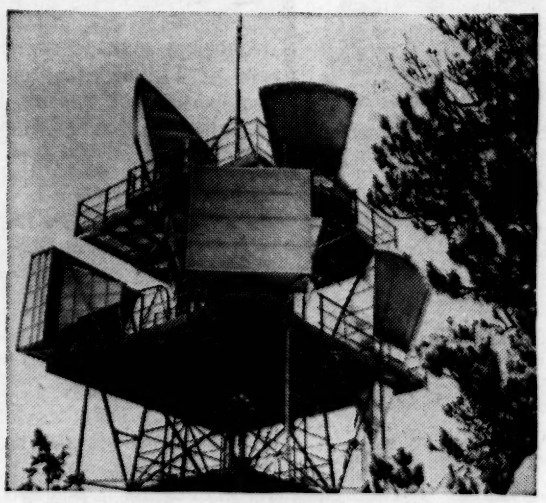


It was building fast, reliable communications for BMEWS—the nation's Ballistic Missile Early Warning System.

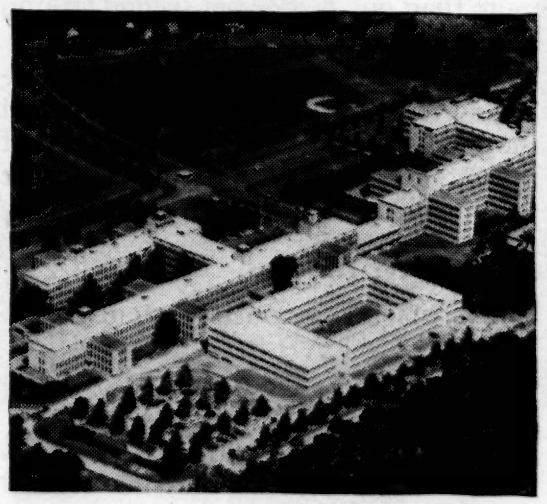
It was constructing a 'round-the-world communications system for America's first man (or woman) into orbit.



It was providing circuits for the speedy transmission of mountains of data for business and government.



It was providing thousands of miles of high-quality circuits for the country's local and network television programs.



And it was delving into innumerable fields of scientific inquiry at the largest industrial laboratories in the world.

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radio links which are needed for tracking, commanding and telemetering. Commands are transmitted by pulse-code modulation. Telemetering equipment sends both narrow-band and digital data in pulse-code modulation form. Television signals are originally in analog form, but are converted for transmission from wide-band telemetry.

All these communications links are tied to the Minitrack system.

Grumman's Group

OAO project organization, now numbering about 85 engineers and expected to total 120 at the peak, was developed from the company's Space Sciences Group. The group was originally directed by Walter H. Scott, Jr., chief of preliminary design; Scott has now become program manager for the OAO.

OAO project organization parallels the classical form of engineering organization, but also uses specialists and group leaders from Space Sciences to bolster the force as needed. Engineers on the job report through a vertical line to Joe Gavin, Grumman's chief missile and space engineer. Scott, as program manager, has over-all responsibility for all phases of the OAO development, construction, testing and operation.

Growth of the Space Sciences Group dates back to 1958, but there was considerable agitation before that time for the company to get deep into space activity. The first serious effort made was the preparation of Grumman's proposal for Project Mercury; they finally ran a close second to McDonnell's winning design. Former NASA Administrator T. Keith Glennan, in later testimony to Congress, said that Grumman's heavy load of Navy designs in conceptual phases at the time of the competition weighed heavily against choosing that company's proposals. Grumman's bid was nearly $10 million higher than McDonnell's.

Grumman designers followed with a series of company-funded studies of unmanned space lunar craft, reasoning that this would be the next area for proposals. Shortly after this work was started, it was split into two phases, one for manned vehicle studies and the other continuing the unmanned vehicle work. Out of these grew the company's proposals for the Apollo spacecraft.

Group Policy

Policy of the group right now is to study and develop its capability in the design of spacecraft, and then to go after selected designs in competition. They feel it is more important to concentrate their efforts on designs where their real competence shows than to use the "shotgun" technique and send out proposals for every request to bid.

Part of this competence had to be acquired by experience; it could not be

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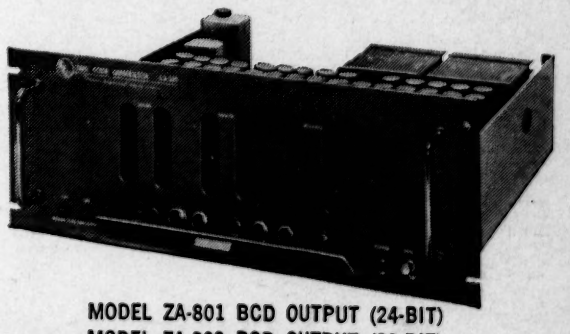

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MODEL ZA-803 BCD OUTPUT (20-BIT)

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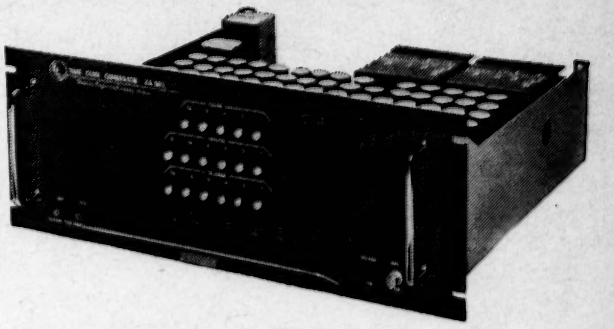

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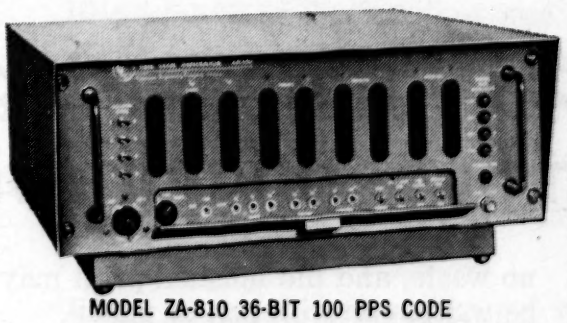

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bought. But part of it could be bought in Grumman's advanced facilities and specialized laboratories where engineers and technicians could test hardware and components under the weird conditions of space environments.

Not specifically tied to any one project, these facilities will give Grumman continuing capabilities in the areas of avionics, materials, fluid mechanics, environmental test and telemetering. The company owns most of these facilities and developed them with its own money. Current investment in plant and equipment is estimated at about $8 million, with more scheduled to be spent as future needs warrant.

The cost of these facilities, plus other money diverted into the company's space projects, currently totals about $10 million. Grumman project personnel look on this as the company's investment in the future, a future which they feel more confident in facing because of that investment.

Foreign Polls Show U.S. Prestige Loss

Washington—Foreign public opinion places the United States second to the Soviet Union in the space field and expects Russia to achieve military superiority over the United States, according to a survey released by the U.S. Information Agency.

Other findings on U.S. international prestige—a major political issue in last year's presidential election—were:

- **Prior to Sputnik I** and the development of intercontinental ballistic missiles by Russia, the United States enjoyed "a clear preponderance" of overall national power in world opinion. "The current consensus would appear to be that the USSR now enjoys a rough but effective equivalence in strength over-all," and the trend is adverse to the United States.
- **"The enduring prevalent image** of a substantial Soviet advantage in space . . . appears to rest on a strong belief that the USSR has got there 'fustest with the mostest,' and 'most' is apparently based on a more complex calculation than simple enumeration. Number apparently has not captured the public imagination as mass, range, and primacy seem to have done."
- **Popular acceptance** of the idea that a "nuclear stalemate" exists is increasing.
- **There is a preponderance** of belief that the USSR rather than the United States would win a conventional war.
- **Although the U-2 incident** disclosed that the United States had been able to fly through Russian defenses and obtain military intelligence, this did not affect world opinion on U.S. military standing vis-a-vis the USSR.

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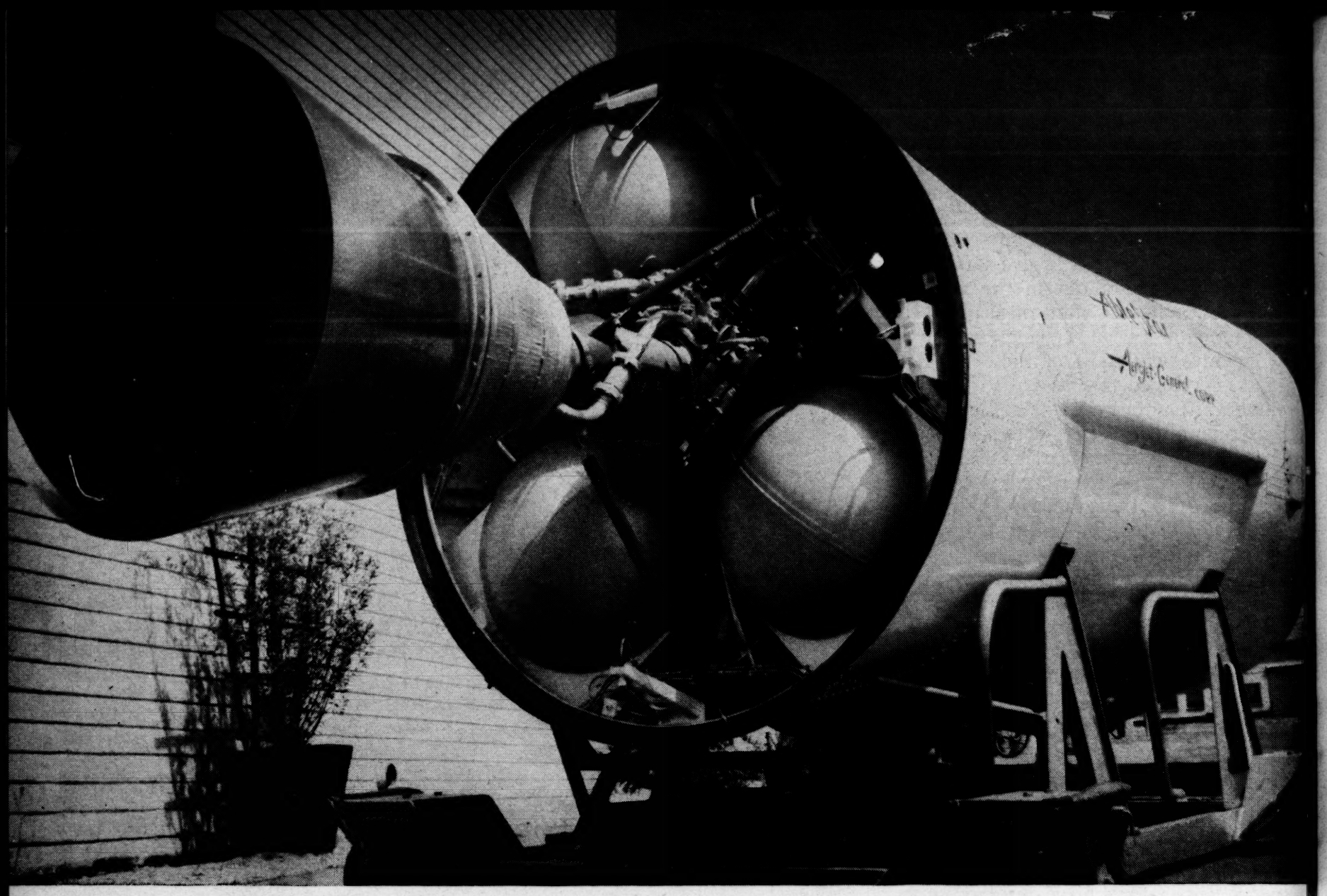

Aerojet General's restartable Ablestar upper stage uses three titanium pressure bottles for a weight-savings of 60 pounds. The nozzle extension is also titanium.

How Titanium pressure bottles reduce missile weight

Trend based on metal's high performance, fabricability and immediate availability suggests retrofit applications

The swing to light-weight, high-strength titanium metal for pressure bottles in the current generation of liquid-fueled missiles provides conclusive proof of the design advantages and reliability inherent in titanium construction. (See box score)

This state-of-the-art report, prepared by Titanium Metals Corporation of America, outlines performance, price and fabrication histories of the Ti-6A1-4V grade as attested to by those who know the metal best—the firms that realize its benefits most.

Titanium's performance history may thus chart a path to important weight reductions in space probes, as well as in orbital vehicles and manned missiles. Titanium pressure bottles are now solving weight and reliability problems in complex pressurization, restart, actuation and stabilization devices.

Suggested also by this trend are a number of retrofit applications of titanium pressure bottles in aircraft... cockpit pressurization, ejection, and other pneumatically controlled and actuated systems.

HIGH STRENGTH-TO-WEIGHT RATIO The metal's most important attribute can be summed up in a few words *... titanium is 44% lighter than steel at the same strength.* In addition it has ...

RELIABILITY AT CRYOGENIC TEMPERATURES Unlike many metals, titanium retains good mechanical properties as the temperature drops. Titanium pressure bottles have shown high strength, ductility, impact resistance and low notch sensitivity at temperatures below *minus* 300F and working pressures up 9,000 psig. *There is no evidence of a single failure in service.*

MECHANICAL PROPERTIES According to Mr. Abe Hurlich, Supervisor, Materials Research Group, Convair-Astronautics Div., General Dynamics Corp., Ti-6A1-4V vessels display the following mechanical properties (note especially retention of ductility):

BOX SCORE ON TITANIUM PRESSURE BOTTLES

60 pounds saved in Ablestar First successful rocket engine to be restarted in space uses three spherical titanium pressure bottles to hold helium at 4,350 psig for the pressure feed system. According to Aerojet Spacecraft Division, Aerojet General Corporation, designers and builders of Ablestar, the titanium (Ti-6A1-4V) pressure bottles saved a total of 60 pounds over steel.

Titan losing 150 pounds Martin Company reports that it is in the process of switching from aluminum to titanium (Ti-6A1-4V) bottles and is saving 150 pounds in each missile! Four spherical bottles, containing helium, furnish pressure for fuel and LOX systems. Two are used in each stage and are contained inside the LOX tank. In addition to high strength-to-weight ratio and cryogenic properties, Martin listed the "availability" of titanium pressure bottles as a factor in the change.

High performance dictates titanium in Agena Lockheed Aircraft Corporation reports that titanium's high performance, as well as its light weight, was important in the choice of Ti-6A1-4V alloy for spherical helium pressure bottles used in Agena "A", satellite for the "Discoverer" program. An average of 8 pounds per bottle were saved, according to Lockheed engineers. From three to five bottles, depending on the program, are used as reservoirs for the cold gas reaction jets in the stabilizing system.

325 pounds saved in X-15 Four Ti-6A1-4V titanium bottles that store helium at 3,800 psig are used in the X-15 "manned missile," for a weight-savings of 325 pounds over the original Inconel X bottles. A 96″ x 14″ cylindrical bottle operating at −300F, pressure feeds LOX and ammonia to the engine through a reducing valve. Three spherical bottles pressure-feed hydrogen peroxide to the engine, pneumatically control propellant system valves, and purge the engine for restarts.

Pioneered on Atlas; saves 129 pounds per bottle The titanium pressure bottle was developed to a practical reality on Convair-Astronautics' Atlas. The original stainless steel sphere weighed 205 pounds. The Ti-6A1-4V titanium sphere, heat-treated to 160,000 psi, weighs 75 pounds! Design burst pressure is 5,000 psig at ambient temperature. Actual burst pressures at −320F have been consistently at 9,000 psig and higher.

Mechanical properties: Ti-6A1-4V pressure vessels

	TEST TEMPERATURE 70 F	minus 320 F
Yield strength (0.2% offset)	137,000 psi	229,000 psi
Tensile strength	156,000 psi	236,000 psi
Elongation	16%	11%
Reduction in area	52%	36%
V-Notch Charpy impact energy*	17.5 ft-lb	10.0 ft-lb

*Double width, half-thickness specimen with one-half the standard depth notch.

CORROSION RESISTANCE Titanium's well-known resistance to corrosion is another reason for the metal's growing history of reliability under extreme environmental conditions.

FABRICABILITY—WHAT THE FABRICATORS SAY Most current pressure bottles are being made of Ti-6A1-4V, an alloy heat-treatable to 160,000 psi minimum (on a strength/weight basis, this is equal to steel at 280,000 to 300,000 psi). Construction usually consists of hemispherical forgings machined to precise contours, girth welded and heat treated.

Here are reports from fabricators who helped develop the titanium pressure bottle.

Airite Division of the Electrada Corporation, Los Angeles, California, says, "Titanium can be forged and machined as accurately as steel. We are easily obtaining surface finish of 100 microinches and holding contour and wall thickness to plus or minus 0.005 inches."

Menasco Manufacturing, Burbank, California, reports, "We prefer to use it. Titanium is now as reliable as any other metal and has probably a lower rate of reject. After good fabrication procedures are established, old wive's tales are soon dispelled."

AVAILABILITY AND LOWERING COST The development phase for titanium pressure bottles is now over. Fabricators are producing them on a production line basis. The titanium industry can easily produce the Ti-6A1-4V grade required for the solid and liquid fueled programs in design or development, with capacity now in place. Lead-times are generally short, with TMCA warehousing large stocks of the alloy in Toronto, Ohio and Los Angeles for 24-hour shipment.

Prices of the Ti-6A1-4V grade and fabrication costs have diminished steadily: Metal costs have declined 62.4% since 1955; unit price of the titanium pressure vessels employed in the Atlas has dropped 30% since their first use; a rocket case fabricator recently quoted the steel-titanium price differential at 15%, with the titanium case weighing about 40% less than the steel version.

With materials and fabrication costs amounting to only 13% of the total price of any missile system, designers are growing reluctant to concede quality in the actual vehicle. Titanium, accordingly, suggests serious consideration *today*.

HOW TO USE TMCA INFORMATION RESOURCES If you are now fighting a weight bogey on an assembly that requires structural strength at temperatures between minus 320F to plus 1,000F, while retaining corrosion immunity . . . or if you need information on titanium fabrication . . . missiles applications . . . competent fabricators . . . a letter to TMCA's Technical Service Department would probably go a long way to solving your problems. Why not write today?

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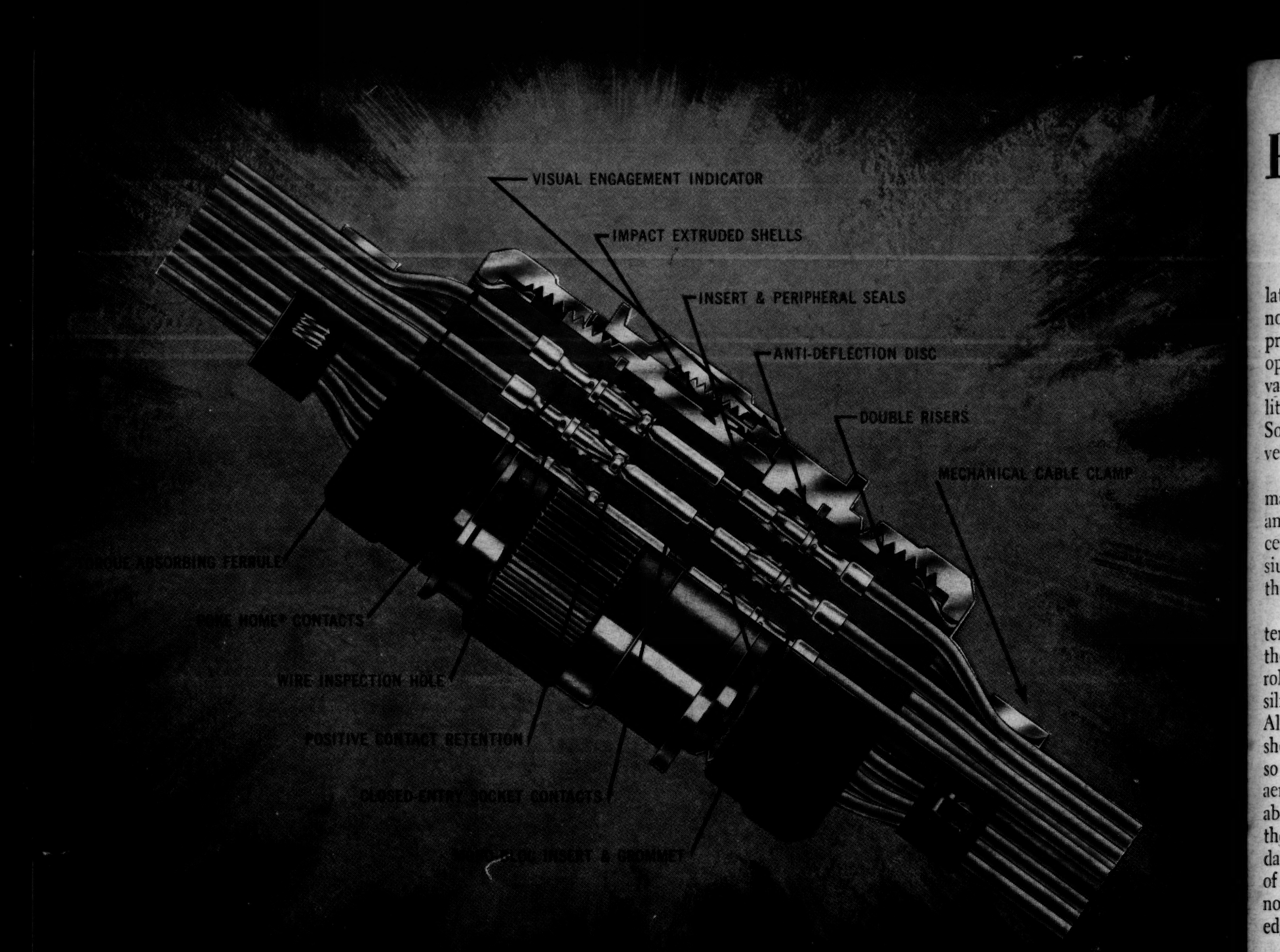

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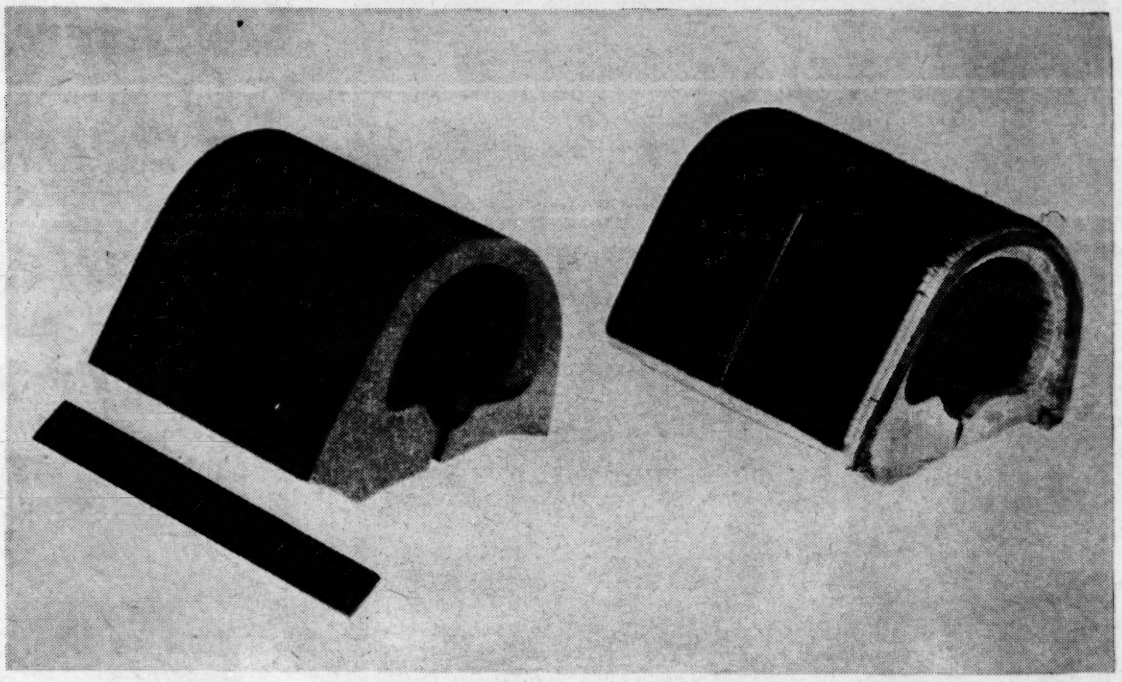
Pyrolytic Graphite Gains as Heat Shield

By Michael Yaffee

New York—Pyrolytic graphite and related new high temperature materials now under development are expected to prove a major factor in the successful operation of Polaris A-3 missile, advanced Samos E-6 reconnaissance satellite, Apollo, Skybolt, Nike Zeus, Dyna-Soar and other future missile and space vehicle systems.

Applications of these relatively new materials (AW July 25, p. 26) were among the prime topics discussed recently at two Navy-industry symposiums, the first at Aerojet-General and the second at Lockheed.

The materials currently of prime interest are straight pyrolytic graphite and the newer, higher strength alloys of pyrolytic graphite co-deposited with boron, silicon, hafnium, cobalt or columbium. All these pyrolytic graphite materials shed heat principally by radiation and so avoid most of the material loss and aerodynamic alterations associated with ablative heat shielding. At this time, these materials look like strong candidates for the three most critical types of aerospace vehicle structures: thermal nose shields, rocket nozzles and leading edges.



HIGH TEMPERATURE leading edge, under study by NASA, is designed to improve normally low ductility of graphite structure. Picture shows straight graphite structure before (left) and after it was coated with pyrolytic graphite by General Electric.

Polaris Application

Neither the Navy, which is the principal sponsor of this work, nor Lockheed or Aerojet, the contractors through which most of this work is funneled, are believed definitely to have committed themselves to the use of these materials. At the same time, it now appears very likely that pyrolytic graphite structures will find their first operational use in the advanced, 2,500-mi. Polaris A-3 missile, where they may replace the beryllium nose cone and tungsten nozzles used in earlier versions of the missile. Several other applications are under serious consideration, and some are in the evaluation stage.

Among the applications that are likely to develop for these materials later are the following:

• **Blast tubes** in the Skybolt ALBM and the Nike Zeus anti-missile missile. Blast tubes that carry exhaust from the combustion chamber to off-center nozzles must withstand particularly severe heating at the elbows where the exhaust is turned. General Electric, High Temperature Materials, Inc., and Raytheon have produced elbow sections of pyrolytic graphite and PG-boron alloy, and some of these are believed to have been evaluated by Douglas with favorable results.

• **Nose cap** on GE's advanced Samos E-6 satellite. Although the final design of this vehicle has not been decided, there is a possibility that it will look like General Electric's RVX-1 and RVX-2 (bullet-shaped with a short flared skirt) re-entry test vehicles, conceivably with the addition of fins. If this proves to be the final design, the vehicle will probably use a pyrolytic graphite nose cap; and, if the vehicle is designed with fins, then these will likely have PG leading edges.

• **Nose cone and leading edges** for the Dyna-Soar. At the present time, pyrolytic graphite structures are not programed for the Dyna-Soar. For the nose cone which will be designed to withstand 4,300F, Chance Vought reportedly plans to use a siliconized graphite structure interspersed with zirconium oxide rods normal to the surface. For the leading edges which will have a design temperature of 2,900F, Boeing is believed to be considering structures made of molybdenum and coated with molybdenum disilicide for oxidation resistance (AW May 12, 1958, p. 69). Both these structures, it is believed, would have high emissivity surfaces of approximately the same 0.8 value as that of pyrolytic graphite and would work mainly by radiation. Pyrolytic graphite producers, however, feel they can make more efficient and reliable structures and are hoping to get back-up or second source contracts to prove it.

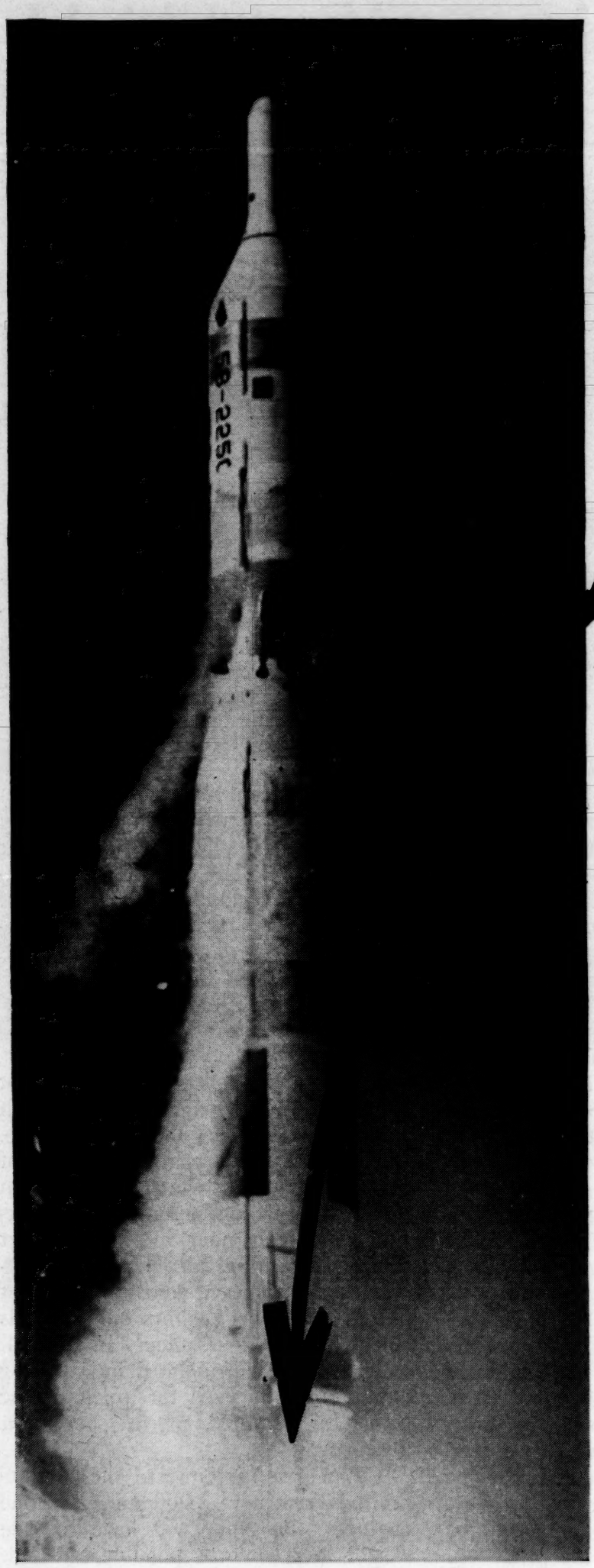
• **Apollo nose caps** and leading edges. Producers of these new pyrolytic materials feel that all future manned space vehicles facing severe re-entry conditions will require PG leading edges and nose cones. But at the present time, this is still mostly conjecture on their part.

In the case of the Polaris, pyrolytic graphite and PG-alloy structures are past the conjectural stage. Atlantic Research, under Navy contract, recently static tested a solid propellant rocket nozzle made of High Temperature Material's Boron Pyralloy. In a 60-sec. run, the nozzle reportedly withstood temperatures of approximately 6,300F much better than the heavier tungsten nozzles designed for the Polaris.

Weight Factor

A pyrolytic graphite heat shield for the Polaris is expected to weigh as much as the missile's beryllium nose cone. But the high thermal anisotropy of pyrolytic graphite, which makes it an excellent heat conductor in one direction and a very poor one in the other (temperature drops of 4,000F reportedly can be achieved across a section of one of the new PG-alloys only 60 mils thick), is said to effect an over-all weight saving of more than 50% by eliminating the need for much of the insulation required in the beryllium nose cone.

To increase the range of the volume-limited Polaris by 1,000 mi., says one engineer, the Navy will have to save weight everywhere it possibly can and, more important, increase the combustion temperature of the solid propellant to a point conceivably beyond the 6,200F melting point of tungsten. The Navy says that it is not yet committed to the use of pyrolytic graphite on any of its missiles but, one Special Projects Office (Polaris) scientist told AVIATION WEEK, "A material this promising is bound to have all sorts of applications." As developments now stand, a rocket nozzle is expected to be the first pyro-



It can't be seen, but within the smoke created by this typical launching, often sits a TE-9-B camera, giving a close-up view of launching conditions to remotely located observers.

General Electric's new TV camera gets the picture 10 feet from blast-off

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General Electric's years of experience in the closed circuit TV field include installations at Cape Canaveral, Vandenburg, Patrick, Forbes and Warren AFB's. Highly skilled specialists help plan, design and install the system *that meets your specific requirements*. For complete information, contact Section 5421-13, Technical Products Operation, General Electric Company, Lynchburg, Virginia.

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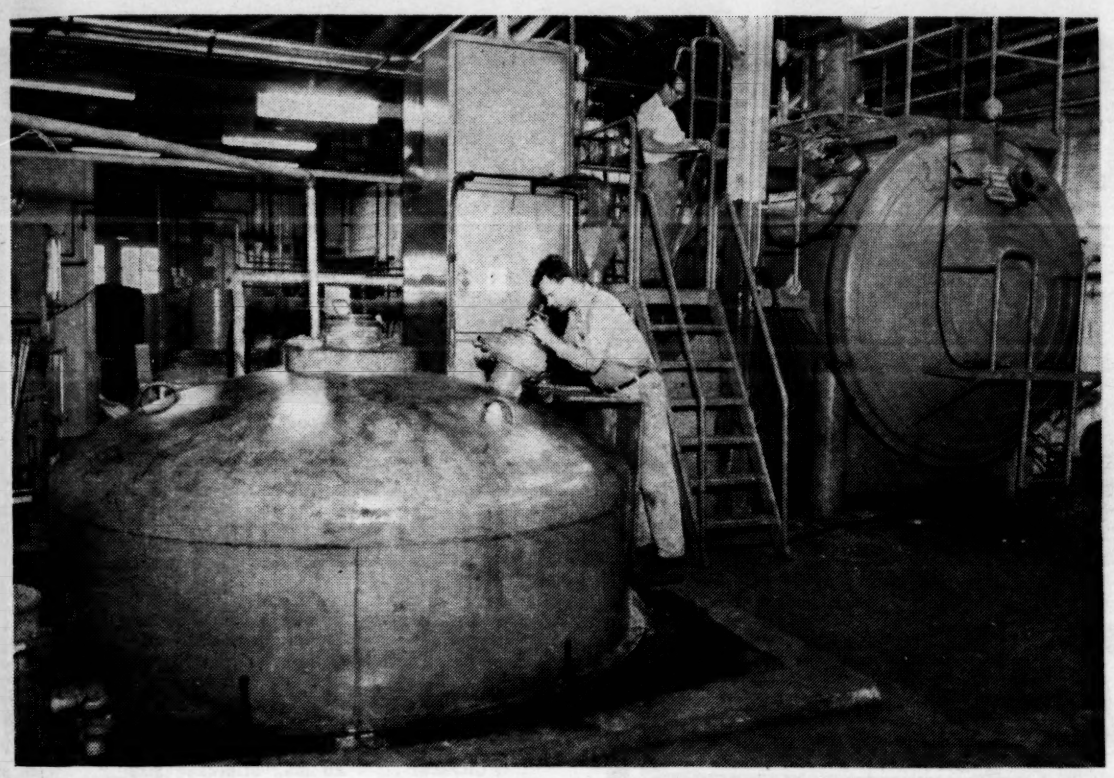

TECHNICIAN at GE plant uses an optical pyrometer to read temperature inside 9-ft. x 14-ft. pyrolytic graphite furnace. At right is 6-ft. x 6-ft. horizontal pyrolytic graphite furnace.

lytic graphite structure that actually flies but a PG thermal shield will probably be the first structure to become operational.

Lockheed reportedly has carried out some experimentation of its own on making pyrolytic graphite nose cones by pyrolyzing conventional plastic thermal shields. But it is believed that this work is mostly of an exploratory nature and that operational PG structures will be produced by one of the materials groups now in the field using vacuum deposition of pyrolytic graphite (from a cracked hydrocarbon gas) on a regular graphite mandrel (AW July 25, p. 26).

General Electric's Metallurgical Products Department has just installed two new PG furnaces in its Detroit plant. Each is 7 ft. in diameter and 14 ft. long and has an internal working area that is believed to be large enough to fabricate a full scale Polaris nose shield. The department has two other furnaces already in operation in the same plant; one is 9-ft. x 14-ft. and the other 6-ft. x 6-ft. The company also has a number of smaller furnaces which are used for research and development.

PG Furnaces

High Temperature Materials has 24 pyrolytic graphite furnaces in operation at its Brighton, Mass. and Lowell, Mass. plants, ranging in size from small research and development ovens to large production furnaces.

Internal dimensions or working areas, of these units run from 3-in. x 6-in. to 30-in. x 80-in.

At the present time, Raytheon is operating only small, development size furnaces but plans to procure production size facilities. The extent to which the company will buy and install the full scale units will be "determined by the amount of business" that can be foreseen for the material. Two other companies which currently have some pyrolytic graphite production capability are National Carbon and American Metal Products.

Problems Cited

There are still a number of problems associated with the production and use of pyrolytic graphite structures. Among the more important problems which have been pointed out by producers are the following:

• **Low ductility.** The material's brittleness has led to difficulties in production, handling and application. During manufacturing, pieces often crack or delaminate due to internal stresses, producers say.

• **Joining.** Feasibility of joining or bonding the material has been demonstrated, but a lot more work is needed on the joining of pyrolytic graphite to itself and to metals and ceramics. For low temperature applications, the material can be bonded with adhesives. In the case of a nose cone, the PG shield will probably be slipped over a thin metal back-up structure and the space between the two filled with a potting compound. Re-entry vehicle components would be attached to the metal shield which would also serve to keep the melted potting compound from getting inside and gumming up the components.

• **Quality control.** Despite recent advances, more work is needed on determination and classification of the material's properties and development of testing techniques. The goal here is to achieve reproducibility in properties from one unit to the next. In the last six months, say manufacturers, a great deal has been accomplished along

example...

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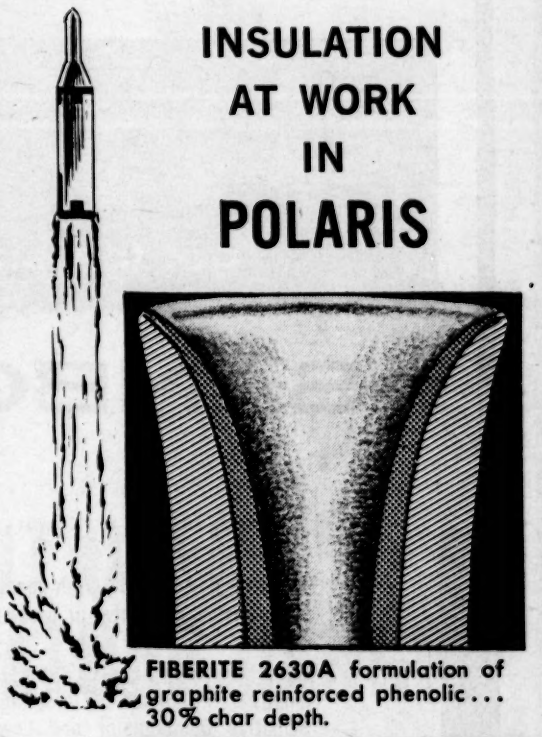
INSULATION AT WORK IN POLARIS



FIBERITE 2630A formulation of graphite reinforced phenolic... 30% char depth.

Char Depth

Standard graphite reinforced phenolic 100% char depth.

The development of special Fiberite MX 2630A formulations reduce char depth of graphite reinforced phenolic molded insulations up to 70%, thus permitting the use of these materials in more critical solid propellant rocket motors.

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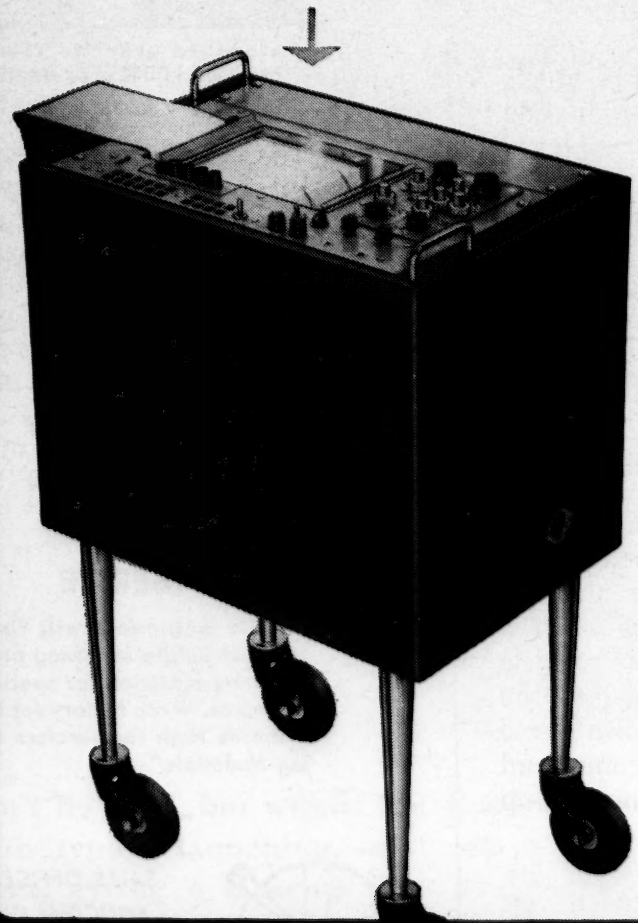

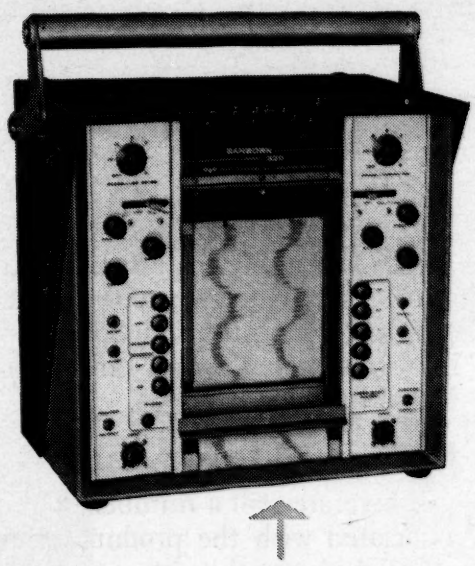

Two 50 mm wide channels . . . separate floating input DC amplifiers . . . 4 chart speeds . . . mv or volt inputs

Operate this 1-cubic-foot recorder vertically, horizontally, or tilted at a 20° angle on carrying handle. Inputs are floating and guarded . . . 12 sensitivities from 0.5 mv/mm to 20 v/cm . . . response DC to 125 cps within 3 db, at 10 div peak-to-peak . : . max. nonlinearity 0.25 mm . . . common mode rejection 140 db min. DC . . . built-in 10 mv calibration signal and electrical limiting . . . internal 1 sec. timer . . . monitor output connectors for each channel. Galvanometers are rugged, low impedance type with velocity feedback damping; most circuitry for each channel is mounted on a single, easily serviced card.

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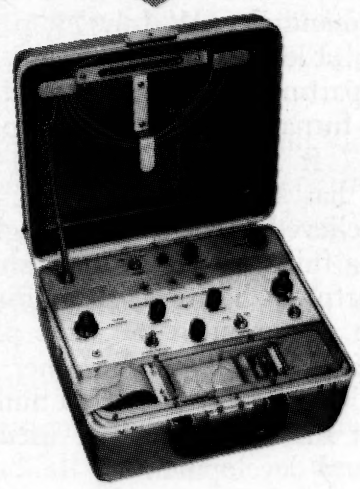
Extremely compact, highly versatile recorders for general purpose DC inputs (Model 299) and AC strain gage recording (Model 301). Two chart speeds: 5 and 50 mm/sec . . . inkless, rectangular coordinate recording . . . response from DC to 100 cps within 3 db, at 10 div peak-to-peak . . . gain stability better than 1% to 50°C and for line voltage variation from 103 to 127 volts. Model 299 has balanced to ground input, 10 switch-selected sensitivities, calibrated zero suppression. Model 301 has wide sensitivity ranges, can be used with strain gages and inductive transducers, provides excitation voltage of approximately 4.5 volts rms at 2400 cps, and has uncalibrated zero suppression.



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this line, particularly in the uniform production of large pieces.

Of all the problems, say the producers, perhaps the biggest one associated with pyrolytic graphite (as well as with other new high temperature materials) is learning how to work, particularly design, with brittle materials. An example of some progress in this area is a new leading edge structure suitable for vehicles such as Dyna-Soar which is now being investigated by NASA. The rounded edge is made of graphite and then coated with pyrolytic graphite. It is hollow, not joined at the back and has some give when compressed. The edge would be attached to the rest of the wing compressed by a metal clip which would fit inside the unit. The significant thing in the design area, the producers declare, is that they are now being given more of a voice in the design of different structures rather than simply being handed, as before, a set of blueprints and told to make the unit out of pyrolytic graphite.

Another objective of PG suppliers is increasing the material's oxidation and erosion resistance, particularly for nozzle use. There has been some work on the development of protective coatings from refractory metals such as molybdenum. Developments offering more promise in this as well as other problem areas, say some suppliers, are the new co-deposited alloys. The technology of these new alloys is considered to be about a year behind that of the straight pyrolytic graphite.

Formation of Alloy

The alloys are made in the same equipment and in much the same manner as the straight pyrolytic graphite. However, besides the gas from which the PG is obtained, a material such as boron, silicon, hafnium, niobium or cobalt is fed through a separate tube into the furnace. So far, most of the work appears to have been done with boron. Usually, the alloying material is used in the form of an organic compound (in the case of boron the chloride has also been used) which is generally heated to its volatilization point before it enters the furnace. At the higher temperatures inside the furnace, the alloying element separates, says General Electric, and co-deposits with the pyrolytic graphite as straight boron or, depending upon time and temperature conditions, can combine with some of the graphite to form boron carbide.

One of these new materials is now being offered for evaluation by High Temperature Materials under the name of Boron Pyralloy. Increased hardness and finer grain structure of PGB, says the company, results in easier machining and better oxidation resistance. Due to the stress of differential ther-

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These Kearfott DC tachometers are unusually durable and specifically designed to provide reliable service over a long life. R9608-001 is an uncompensated unit ideally suited to function as a stabilizing element in a standard DC servomechanism. The R9608-002 model offers the precision required in computing applications and is temperature compensated to maintain its high accuracy over the temperature range of −15°C to +71°C, with variations of no more than .1% of values specified at 25°C.

		R9608-001	R9608-002
TYPICAL ELECTRICAL DATA	Output (volts/1000 rpm)	7 (typical) .5-30 available	2
	Rated Speed (rpm)	3600	5000
	Linearity (% to 3600 rpm)	.07	.1
	Winding Resistance (ohms)	125	
	Output Impedance (ohms)	—	36
	Ripple Voltage	2% above 100 rpm	2.5% at 3600 rpm
TYPICAL MECHANICAL DATA	Friction Torque (in. oz.)	0.25	0.25
	Rotor Moment of Inertia (gm-cm²)	7	8
	Weight (oz.)	5.5	5

Write for complete data

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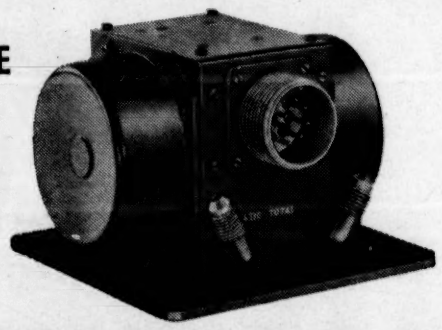
ANOTHER COMPLEX AIRBORNE COMPONENT FROM GIANNINI CONTROLS



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Missile tray made by Brooks & Perkins *beats target weight by 300 lbs.*

Air transported missiles require minimum weight handling equipment so that important defense weapons can be moved efficiently and on schedule. Recently, Brooks & Perkins was given the responsibility for engineering, designing, building the prototype and manufacturing an aluminum missile tray, shown above.

Unusual loading problems and the extreme importance of deflection required a dimensional tolerance of ± 1/32″ in the 33-foot over-all length at 68°F. B & P not only met all tolerance requirements, but also reduced the initial target weight by 300 lbs.

The aluminum missile tray is another example of Brooks & Perkins skill and experience in the fabrication of light metal products for ground support equipment.

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mal contraction, making PG configurations which had small radius curves was difficult. But it can be done with PGB because of the new alloy's greater strength, says the company.

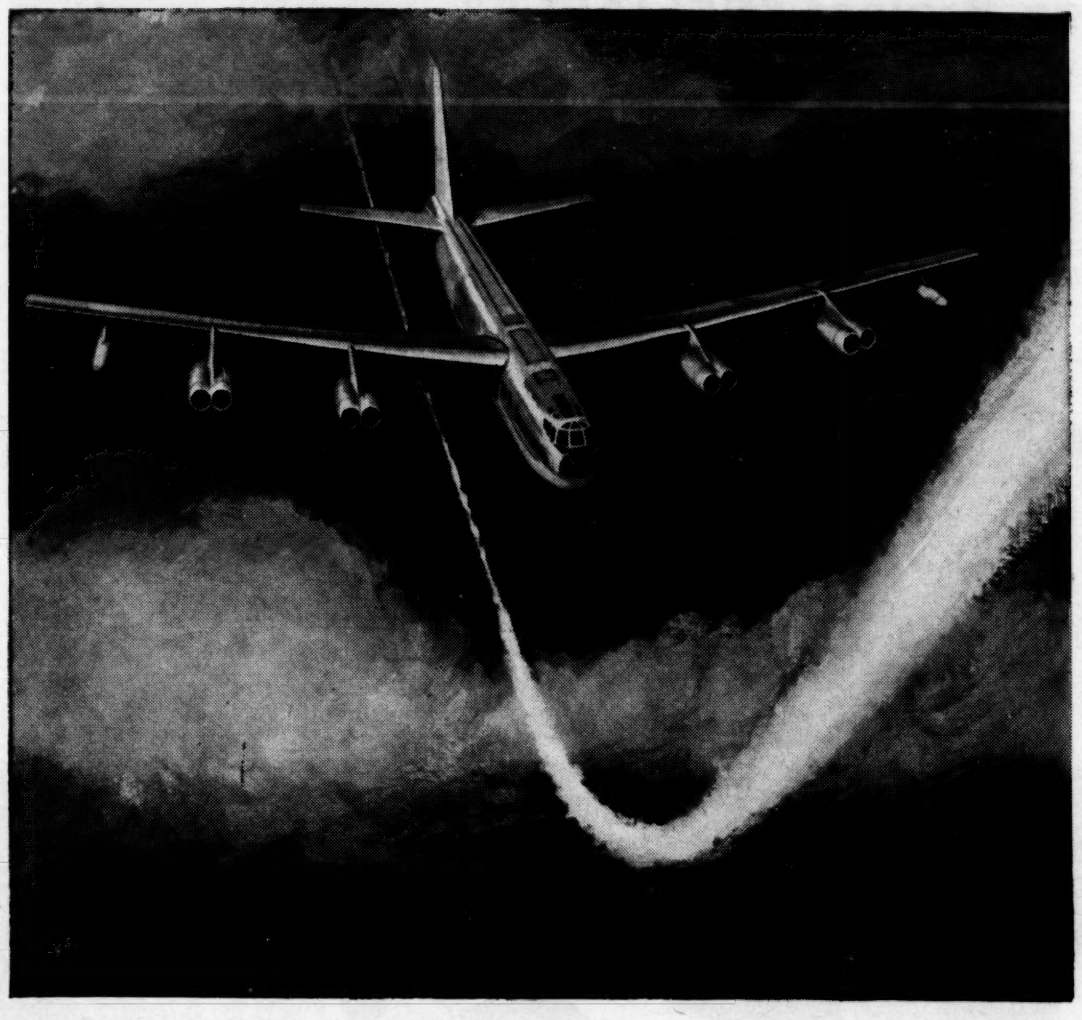
In bent test samples, according to High Temperature Materials, PGB has shown an ultimate bend strength of 37,000 psi.; straight PG, 22,000 psi.; and graphite 2,500 psi. PGB is also said to provide 53% better insulation than PG, 70% greater elasticity, and a significantly reduced tendency toward crack propagation during machining.

Tensile Strength

General Electric also reports that co-deposition appears to improve straight PG's low tensile strength in the "c" direction (perpendicular to the surface) as well as its oxidation and erosion resistance. But co-deposition may prove to have its greatest attraction for the nuclear energy field wherein it can be used for adding materials to PG to alter certain properties such as a neutron cross-section.

General Electric is looking at co-deposition as part of an effort to come up with a controlled conductivity material. The idea briefly is to turn more of a PG heat shield into a heat sink, by depositing heat conducting metals at points where maximum heating occurs, in order to reduce oxidation and erosion. Normally, a pyrolytic graphite heat shield with an emissivity of .8 will reradiate 80% of its heat load during re-entry. The remaining 20% will go into oxidation and erosion of the shield. By conducting more of the heat into the shield, says GE, it might be possible to soak up half of the 20%, leaving only 10% for erosion and oxidation. This is not expected to affect the structure's insulating ability, a GE scientist points out, because a PG heat shield will be made thicker for structural strength than it has to be for thermal reasons. But all this work, he adds, is still in a very early stage.

In equipment similar to that used for the work on pyrolytic graphite, General Electric is also carrying out an extensive research program on single crystal sapphire (aluminum oxide) whiskers. The goal of this program is to develop a whisker-reinforced metal composite material which has a strength-to-density ratio of 600,000 in. at 2,000F. So far, the company has succeeded in growing whiskers that individually have been tested to a tensile strength of up to 1,700,000 psi. at room temperature. As a result of inadequate bonding technology, however, when the whiskers are set into the metal matrix and tension applied along the axis of the crystals, the tensile strength drops drastically because the stress is transferred by shear to the adjacent whiskers.



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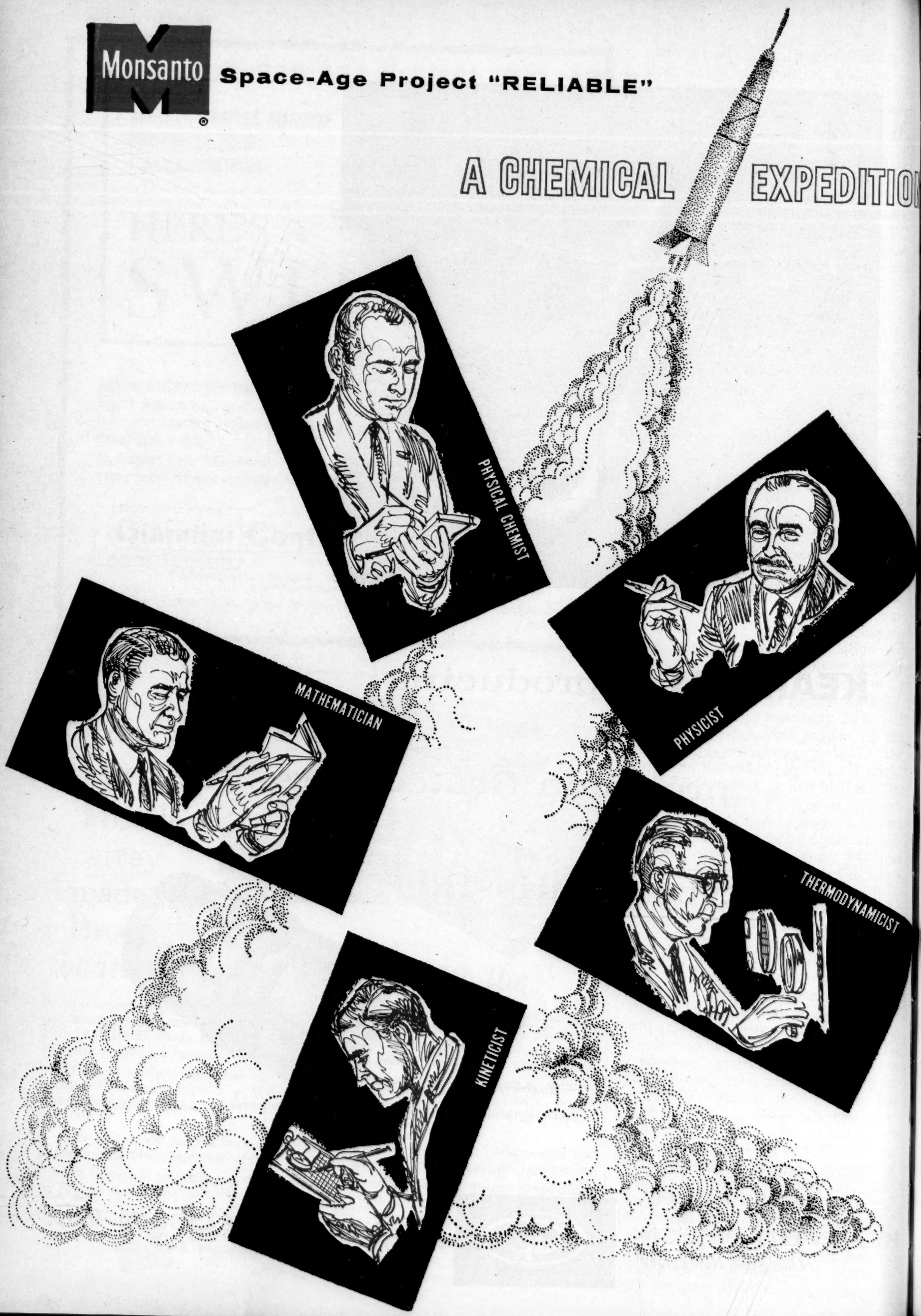
Space-Age Project "RELIABLE"

A CHEMICAL EXPEDITION

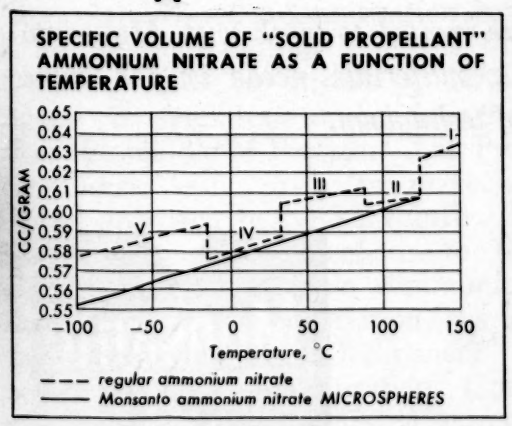


probing the chemistry of nitrogen compounds ...develops new oxidizers that improve the efficiency and reliability of solid propellants

Monsanto has developed "MICROSPHERES"—a new unique form of nitrate oxidizer that gives greater packing density, a more predictable burning pattern, and greater reliability to solid propellants: Most important, the oxidizer is low-cost, heat-stable, and forestalls cracking of the grain as the propellant mass burns.

By applying advanced technology in physical chemistry to the problems of nitrate oxidizers, Monsanto has developed ammonium nitrate MICROSPHERES for solid rocket propellants. MICROSPHERES have a lower coefficient of expansion and a *linear* expansion with heat to prevent cracking of the "grain" upon temperature change. This oxidizing system is outstanding for improving reliability of production-line low- and medium-thrust solid propellants.

A



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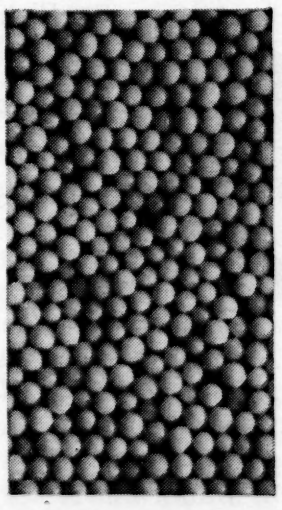

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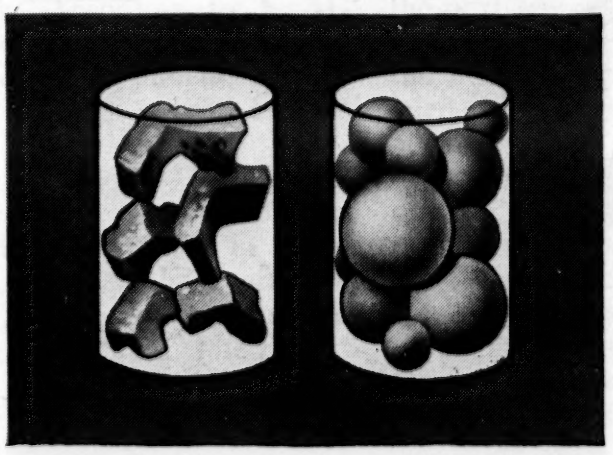


In contrast to high costs and handling hazards associated with other oxidizers, ammonium nitrate MICROSPHERES offer economy and safety. The new physical form increases the efficiency of the thrust and provides mechanical stability during manufacture, storage and burning.

Ammonium nitrate MICROSPHERES are an entirely new oxidizing entity for compounding solid propellants. Unlike ordinary ammonium nitrate, MICROSPHERES do not undergo expansion and contraction from crystalline phase changes, even with operational variation in temperature. (See Graph A.)

The MICROSPHERES make it possible to obtain a higher oxidizer loading for greater propellant efficiency. They are extremely dense. Small, round, and compact—MICROSPHERE particles each contain the greatest mass of chemical energy *per unit* of ammonium nitrate volume. (See Photo B.)

Tightly "packable"—the MICROSPHERES can provide the highest mass of chemical energy *per total volume* because graded sizes give the maximum density packing pattern. Even at a compound density of 1.72 grams per cc., ammonium nitrate MICROSPHERES can provide a *higher packing density* in the grain than commercial ammonium perchlorate at 1.95 grams per cc.!

Diagram C shows why and how MICROSPHERES pack to maximum density. On the left, approximately 34% void space results from using a five mode distribution of irregular-shaped oxidizer particles. On the right, only 15% void space remains with a five mode distribution of regular-shaped MICROSPHERES.

The volume relationship between round MICROSPHERES and irregular-shaped particles in mixed sizes remains approximately the same, regardless of the number of size ranges. Graded MICROSPHERE particle sizes, available in size distribution ranges that peak at 50, 200, and 300 mesh, offer maximum flexibility in controlling packing density. They effectively reduce volume to the minimum.

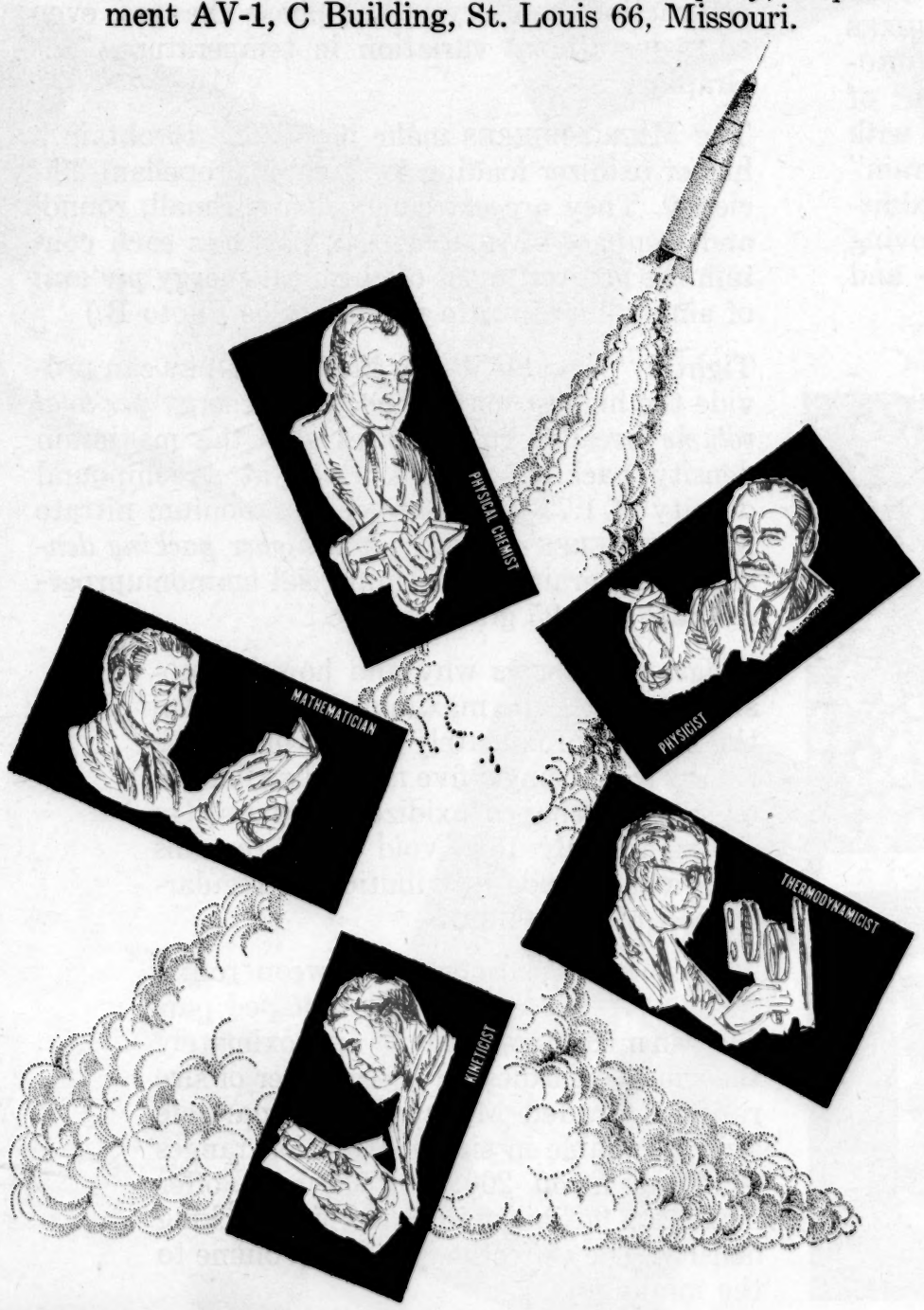
(Please turn page.)

With MICROSPHERES, less binder can be used to obtain better, more-reliable mechanical properties at a higher oxidizer loading. Unlike irregularly shaped particles, their smooth spherical shape does not cause areas of stress under "shaping" or burning deformation. They give better binder-to-oxidizer contact. With minimum plane-to-plane contact between particles, they greatly reduce the incidence of weak spots, cracking, and poor mechanical properties.

As a propellant oxidizer, ammonium nitrate MICROSPHERES offer many other benefits: good storage stability, safety from shock and thermal decomposition, uniform burning rate, smokeless exhaust, and low cost. Mixing of composite propellants is easier because their spherical shape reduces mass viscosity. They usually cut processing time and power input. MICROSPHERE grains are also easier to extrude or cast into the required geometric shapes.

NEW OXIDIZERS FOR ROCKET PROPELLANTS
...a chemical capability of Monsanto

Project "Reliable"—which produced ammonium nitrate MICROSPHERES—is actively investigating other oxidizers for rocket propellants. Monsanto chemical "expeditions" are exploring nitrogen oxides, nitric acid, ammonium salts, and other nitrogen compounds. If you work with propellants, perhaps the materials you need for *your* project can be developed by Monsanto. Write or call: Monsanto Chemical Company, Department AV-1, C Building, St. Louis 66, Missouri.



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U. S. May Orbit Ham Radio Satellites

By Russell Hawkes

Los Angeles—Air Force Ballistic Missile Division is considering a proposal that the first of a series of amateur radio communications satellites be placed in orbit by a Discoverer space vehicle as early as April, 1961.

The proposed series of piggyback satellites is called Project Oscar, an acronym for orbital satellites carrying amateur radios. Launch of the Oscar satellites is to be conducted on the basis of strict non-interference with the primary mission of the launch vehicle. The proposal includes a commitment to avoid any burden upon the money or manpower of the launching agency. Amateurs are to make, test and install everything, including the mounting hardware.

The proposal was delivered by the Project Oscar Assn., a group of amateur radio operators in the San Francisco Bay area organized especially for the purpose. Three months earlier, a member of the association was invited to present the proposal at a meeting of the Joint Chiefs of Staff, who told him that the proposal seemed to have merit and forwarded it to Army Signal Research and Development Agency for endorsement.

Defense Department is advocating creation of an inter-agency governmental committee to coordinate various aspects of the amateur radio satellite program. Officials of the National Aeronautics and Space Administration have heard informal outline proposals that Oscar satellites be carried by NASA Agena B satellites to be launched after the middle of the year. The Project Oscar Assn. plans to make an official approach to NASA shortly. In search of possible objections to the idea of an amateur radio communications satellite, the association has already contacted the Department of State, Federal Communications Commission and other interested government agencies. According to F. H. Hicks, president of the association, the consensus among government officials has been that the idea is both feasible and timely.

Project Oscar is based on the assumption that there are enough radio amateurs who are professionals in space technology to provide an adequate pool of free talent for the development and launching of the satellites. The Project Oscar Assn. was founded by members of the amateur radio club at Lockheed Missile and Space Division in Sunnyvale, Calif., which includes a number of top Lockheed scientists and engineers in government missile and space programs. Since then, the association has been expanded to include Bay area clubs representing about 200 amateurs including professional space technologists employed by Philco Corp,. Ampex Corp. and Eitel-McCullough, Inc. At a recent meeting of the board of directors of the association, it was decided to go ahead with plans to expand the organization once again to bring in more of the 220,000 radio amateurs operating in the United States. Radio amateurs stationed at Cape Canaveral and Vandenberg AFB have already volunteered to serve as installation and checkout technicians in the launch operations. Radio amateurs working at government-operated tracking installations are applying professional background to the problem of designing suitable tracking equipment for amateurs.

Lockheed Connection

Although the Project Oscar Assn. is eager to reserve space on any orbital vehicle, the early connection with Lockheed made it natural to direct first efforts at getting aboard Lockheed Agena B spacecraft to be launched by USAF and NASA. According to present plans, Oscar satellites would be carried piggyback by the Agena B spacecraft and ejected after final burnout to orbit separately. A suggestion that the Oscar package be installed inside the Agena and be turned on only after the primary mission is ended is now being discussed.

Arguments in favor of the amateur radio space program include these:

• **Oscar satellites could be used** to evaluate ionospheric-type repeater units operating in the upper part of the radio frequency spectrum. Sunspot activity occurs in cycles with a period of years. A downward trend can be expected in the next few years and it would be advisable to study this method of using the higher, more sunspot-immune frequencies while the opportunity for exposure exists.

• **Oscar satellites would pay** propaganda dividends. Private citizens in every country would be able to make practical use of a space vehicle for the first time—courtesy of the United States. The peaceful nature of such a vehicle would be beyond question. In the Soviet Union, the government would be forced to choose between jamming the satellite frequencies and letting its citizens participate to some extent in an American space program. In either case, it would be a graphic illustration of U. S. ability to use space vehicles and missiles.

• **The multitude of amateur radio** stations would permit a quicker, more thorough study of radio propagation through the ionosphere over a wide variety of frequencies, paths, and local conditions.

• **Radio amateurs could invite** scientific space projects to use amateur frequencies. Thereby, the scientific projects would ease the traffic load in their own frequency bands and would obtain the services of a large, untapped reservoir of potential tracking stations and data collection sources.

• **United States' 220,000 radio amateurs** have provided an important emergency communications system in the past. Project Oscar would provide them with a new tool to expand their capabilities and sharpen their competence.

As progress is being made in obtaining the necessary support of government agencies with the means of launching space vehicles, construction of the first Oscar satellites is nearing completion. Prototypes have already been operated and evaluated and flight hardware is scheduled to be ready by April. The association originally planned to make balloon-borne flight tests of the first Oscar packages in that month, but Washington support appears to be materializing faster than anticipated and the balloon tests have been eliminated.

Project Oscar is divided into three phases. Phase I is the launch of a series of three-pound canister satellites with tracking beacons transmitting identification-coded signals on a VHF frequency of 145 mc. (amateur radio two-meter band). Continuous wave and modulated continuous wave identification devices will be used. The satellite will carry chemical batteries and the association expects the subminiature, transistorized transmitters to produce a power output of about 100 milliwatts.

The main purpose of Phase I is to give amateurs a chance to improve their competence and modify their equipment in preparation for later, more elaborate space communications efforts. The association will urge observers owning tape recorders to practice recording Oscar beacon signals superimposed on WWV time signals as preparation for future use of active repeater communications satellites. The asso-

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ciation says time of overhead crossing can be measured very accurately by an amateur if he has a means of reading out frequency shift due to doppler effect and plots shift against time.

When an amateur station files a tracking report which can be verified, the successful operator will be notified by mail. The association will try to use established amateur radio traffic nets to relay tracking data to association headquarters. The Military Amateur Radio Service (MARS) has already offered to relay information from overseas and U. S. national nets have been contacted for help in this country.

As Project Oscar expands, the American Radio Relay League will act as the representative of U. S. radio amateurs in planning and coordination committees and will make available its publications and other facilities. The Project Oscar Assn. will probably remain as the working echelon because of its capabilities in space operations.

The association has devised a standard message structure for tracking reports which includes:

- **Alpha**–Greenwich Mean Time at acquisition.
- **Foxtrot**–Greenwich Mean Time at fade-out.
- **Toc**–Greenwich Mean Time of overhead crossing.
- **Observations** and comments.

A typical message in this format might be worded:

"To–:–Project Oscar, Sunnyvale, Calif. Telephone–:–Drexel 9-3682.
Alpha 0538Z, Foxtrot 0546Z Toc 0541Z plus 11.
Regular QSB (variation of signal strength) indicates Oscar tumbling approximately 3-sec. period. Signature.

Phase II of Project Oscar will be the launching of translator-type repeater stations capable of handling a number of conversations at once. The association will not predict exactly how many. The transmitter would be powered by solar cells and the association has been required to design a means of turning it off by remote command to prevent it from transmitting indefinitely on its assigned frequency. The Phase II satellites should weigh about 10 lb. each.

Phase III is devoted to research and its program is still highly fluid. The intensive study of ionosphere penetration at different frequencies is one suggested task. Another is to orbit a 2.5-lb. television package which would transmit its picture on the amateur radio six meter band when interrogated by a ground station. Association President Fred Hicks estimates the picture would be less detailed than a world aeronautical chart, so military and commercial uses would be limited or nonexistent. Since all possible Phase III tasks are still in the discussion stage, no schedule can be estimated.

Services Accelerate Data Exchange Plan

By Philip J. Klass

Washington—The new Interservice Data Exchange Program (IDEP) is gaining momentum with 21 major Air Force, Navy and Army missile and space system contractors and agencies now exchanging data on their component reliability tests to reduce costly duplication of effort (AW Jan. 25, 1960, p. 67).

Approximately 300 individual company component reliability test reports already have been received from participating groups since the IDEP program got under way several months ago, under the sponsorship of Air Force Ballistic Missile Division, according to Martin Barbe who coordinates the program at Aerospace Corp. in El Segundo, Calif. Test data exchanged covers a variety of mechanical, hydraulic and pneumatic components as well as electronic components.

Ultimate Level

When IDEP becomes fully operational, Barbe expects that it will be exchanging approximately 3,000 test reports a year.

This should enable a participating company to save an estimated $250,000 a year in component testing costs, judging from the experience of Sylvania in using a more limited data exchange program operated by Naval Ordnance Laboratory for Polaris contractors.

A Sylvania spokesman says the company has received 147 NOL test data reports to date of which 20 cover components that the company is planning to use. Eight of the 20 tests were conducted under the same conditions which Sylvania needs for its own use and the report data was directly applicable to the company's present needs.

Instead of having to conduct its own extensive tests on these eight types of components, at a cost conservatively estimated at $2,000 per test, Sylvania runs only abbreviated tests using a few samples to check the results of the data obtained from NOL. The latter cost only $350 per component, representing a saving of $1,650 per component or a total saving of at least $13,000 on the eight types.

Multiple Savings

Extrapolating these figures to the 3,000 reports which IDEP hopes to exchange annually gives a figure of about $250,000 saving per company. Equally important, both to the contractor and the government, is the saving in test time and the ability to make better use of over-worked environmental and test facilities.

The component test reports received from individual companies are summarized on cards which measure approximately 8 x 10½ in., which give pertinent highlights of the test conditions and results. A microfilm strip of the complete original test report is attached along one edge of the card to provide detailed information on the tests and their results. The microfilm strip can accommodate up to approximately 50 pages, normally adequate for most reports.

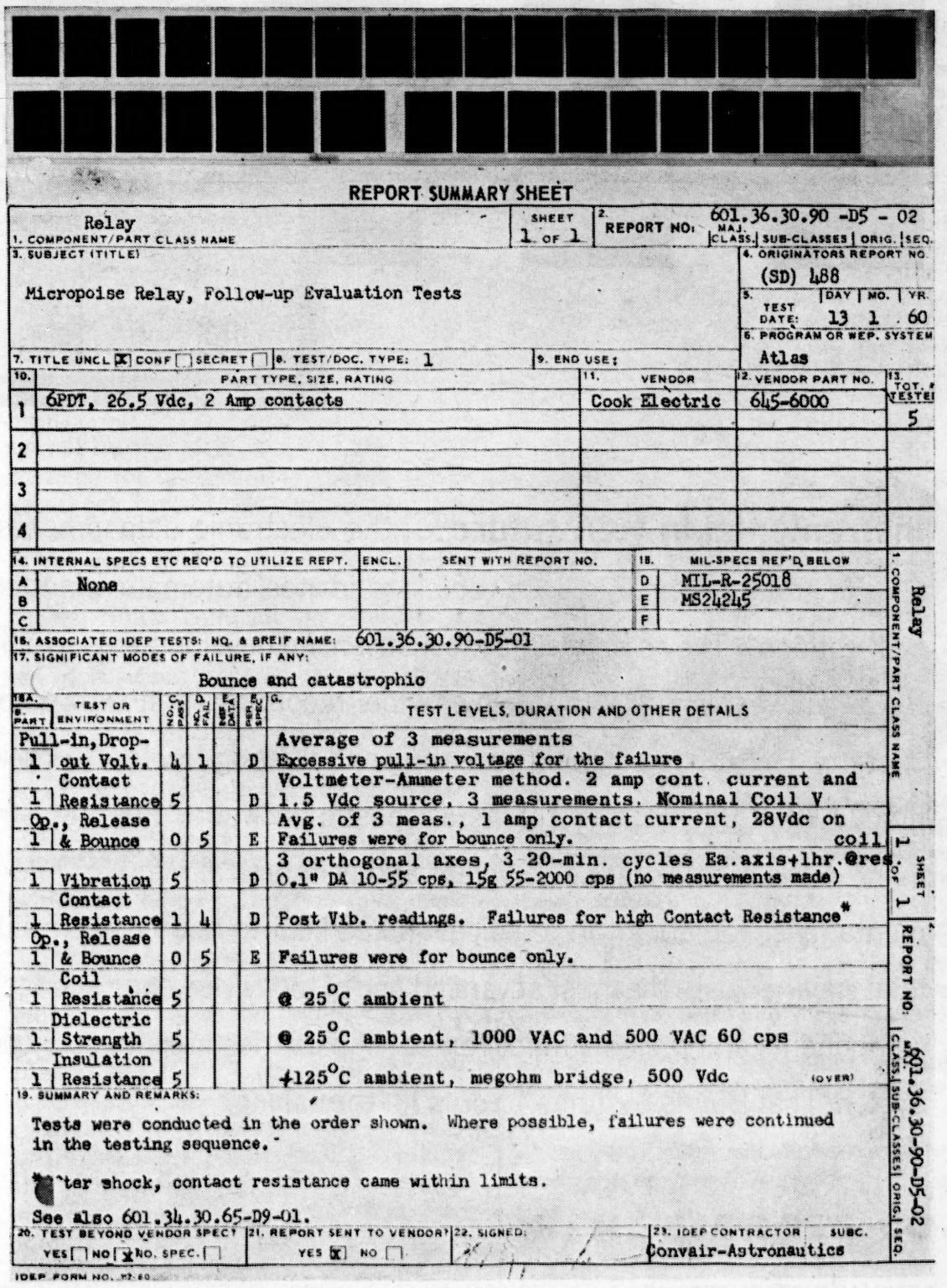
In most instances, the IDEP distribution center is able to prepare the report summary cards, with microfilm strip, within three weeks after the report is received, occasionally requiring a week or two longer, Barbe says.

The summary cards are then distributed to all of the participating companies, plus a select group of additional companies and government agencies. Present distribution list totals about 60 facilities. In some instances, several copies are sent to a company or agency for internal distribution to several interested groups.

Bibliography Issued

Once a month a bibliography is issued which lists all of the new IDEP summary cards that have been issued.

The 21 companies and agencies that are now submitting test reports to IDEP include the following: AC Spark Plug Division of General Motors, Aerojet-General, American Machine & Foundry, American Bosch Arma, Avco,



REPORT SUMMARY SHEET

1. COMPONENT/PART CLASS NAME: Relay — SHEET 1 OF 1 — 2. REPORT NO: 601.36.30.90 -D5 - 02 (MAJ. CLASS. | SUB-CLASSES | ORIG. | SEQ.)

3. SUBJECT (TITLE): Micropoise Relay, Follow-up Evaluation Tests — 4. ORIGINATORS REPORT NO.: (SD) 488

5. TEST DATE: DAY 13 | MO. 1 | YR. 60 — 6. PROGRAM OR WEP. SYSTEM: Atlas

7. TITLE UNCL [X] CONF [ ] SECRET [ ] — 8. TEST/DOC. TYPE: 1 — 9. END USE:

10.	PART TYPE, SIZE, RATING	11. VENDOR	12. VENDOR PART NO.	13. TOT. # TESTED
1	6PDT, 26.5 Vdc, 2 Amp contacts	Cook Electric	645-6000	5
2				
3				
4				

14.	INTERNAL SPECS ETC REQ'D TO UTILIZE REPT.	ENCL.	SENT WITH REPORT NO.	15.	MIL-SPECS REF'D BELOW
A	None			D	MIL-R-25018
B				E	MS24245
C				F	

16. ASSOCIATED IDEP TESTS: NO. & BREIF NAME: 601.36.30.90-D5-01

17. SIGNIFICANT MODES OF FAILURE, IF ANY: Bounce and catastrophic

18A. PART	TEST OR ENVIRONMENT	CONFIG	QUAL	EXTENDED	EQUIP	G. TEST LEVELS, DURATION AND OTHER DETAILS
1	Pull-in, Drop-out Volt.	4	1		D	Average of 3 measurements Excessive pull-in voltage for the failure
1	Contact Resistance	5			D	Voltmeter-Ammeter method. 2 amp cont. current and 1.5 Vdc source, 3 measurements. Nominal Coil V
1	Op., Release & Bounce	0	5		E	Avg. of 3 meas., 1 amp contact current, 28Vdc on coil Failures were for bounce only.
1	Vibration	5			D	3 orthogonal axes, 3 20-min. cycles Ea.axis+1hr.@res 0.1" DA 10-55 cps, 15g 55-2000 cps (no measurements made)
1	Contact Resistance	1	4		D	Post Vib. readings. Failures for high Contact Resistance*
1	Op., Release & Bounce	0	5		E	Failures were for bounce only.
1	Coil Resistance	5				@ 25°C ambient
1	Dielectric Strength	5				@ 25°C ambient, 1000 VAC and 500 VAC 60 cps
1	Insulation Resistance	5				+125°C ambient, megohm bridge, 500 Vdc (OVER)

19. SUMMARY AND REMARKS:

Tests were conducted in the order shown. Where possible, failures were continued in the testing sequence.

*After shock, contact resistance came within limits.

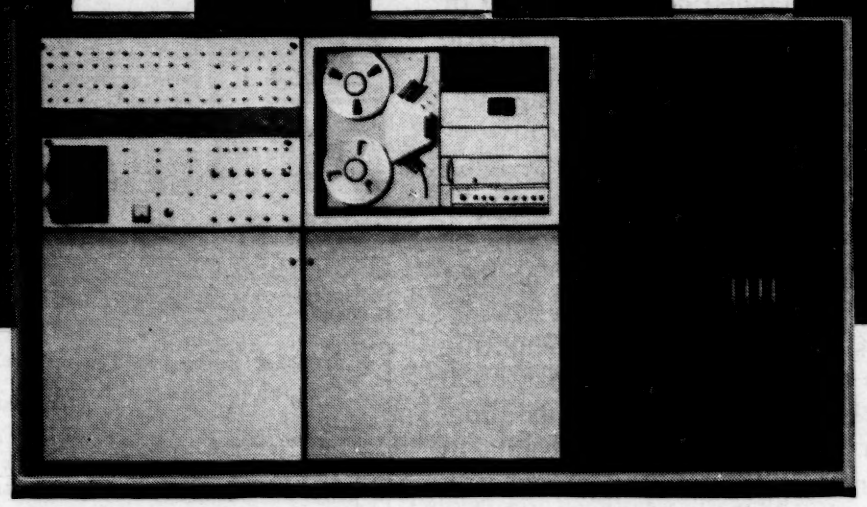
See also 601.34.30.65-D9-01.

20. TEST BEYOND VENDOR SPEC? YES [ ] NO [X] NO. SPEC. [ ] — 21. REPORT SENT TO VENDOR? YES [X] NO [ ] — 22. SIGNED: — 23. IDEP CONTRACTOR: Convair-Astronautics — SUBC.

IDEP FORM NO. 82-60

1. COMPONENT/PART CLASS NAME: Relay — SHEET 1 OF 1 — 2. REPORT NO: 601.36.30.90-D5-02 (MAJ. CLASS. | SUB-CLASSES | ORIG. | SEQ.)

REPORT summary sheet for new Interservice Data Exchange Program (IDEP), used to exchange component reliability test data among missile and space system contractors, contains highlight results of tests as well as complete microfilm copy of report (top).



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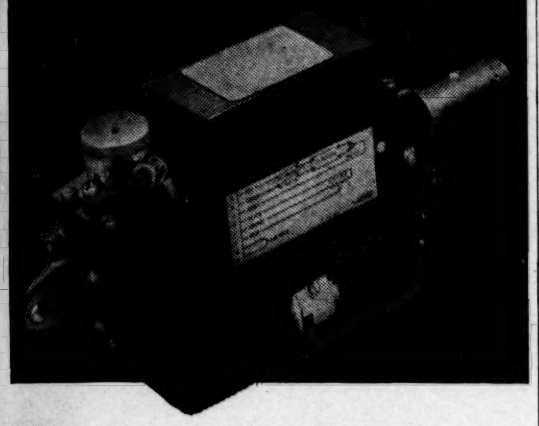
COMPACT AiResearch 60 cycle Actuators *for ground use . . .*



Inexpensive, lightweight 60 cycle motor driven actuators with integral magnetic brakes* are now being manufactured by AiResearch for ground radar, ground support and shipboard use.

Unequalled in 60 cycle performance, these extremely compact, lightweight actuators range from fractional hp motor size up to any desired hp in single phase, two phase and three phase design for a wide variety of applications.

The above-pictured actuator is used in a ground radar system. It is driven by a single phase 60 cycle ac fractional hp electric motor and can be furnished with a feedback potentiometer for use in servo applications. The entire unit weighs only 2½ lb. and is rated at 200 lb. operating load.

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Your inquiries are invited.

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THE GARRETT CORPORATION

AiResearch Manufacturing Division

Los Angeles 45, California

North American Autonetics Division, Bell Aerosystems, Boeing, Burroughs, Convair, Douglas, Eastman Kodak, General Electric Missile & Space Vehicle Department, International Business Machines Corp., Lockheed, Martin-Denver, McDonnell Aircraft, Philco, Rocketdyne, Remington Rand Univac Division of Sperry Rand, and USAF Ballistic Missile Division/Space Technology Laboratories.

Considerable Inertia

Barbe concedes that despite IDEP's obvious advantages and potential savings, it has not been easy to get the program under way and into high gear. There is considerable disparity between the amount of detail that different companies put into their test reports and even considerable variability between individual engineers within a single company.

In some of the larger companies there has been no single central clearing house for test data, making it difficult to expedite the flow of test reports to IDEP and also resulting in duplication of effort even within a single company. One large company recently has set up a system to keep its own decentralized divisions apprised of what component reliability tests are under way, or planned for the near future, so that these tests can provide all the data needed by the several divisions.

Most companies require the preparation of reports when the tests are formal, but the results of an informal spur-of-the-moment test to get quick answers for a specific problem may never get beyond the engineer's clipboard.

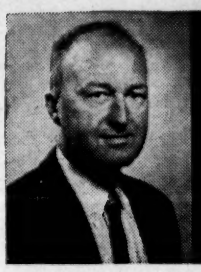
Yet this data might be extremely useful to engineers in another participating IDEP company faced with a similar problem. But because a formal report is never prepared the data does not get into the IDEP system. Barbe says that IDEP hopes to better define the circumstances and kinds of tests which companies should report to the agency.

Speeding Reports

Because many companies take more pains with a report intended for external use than one intended solely for internal consumption, and because of the time required to write and publish test reports, the time lag between test completion and IDEP's receipt of the test report often runs several months.

In an effort to improve the currency of its exchanged reports, IDEP is asking its participating contractors to reduce the lag time to no more than two months.

Barbe is confident these problems will be solved as companies begin to use the IDEP data and see a pay-off in reduced component test time and costs.



PUMP PRIMERS

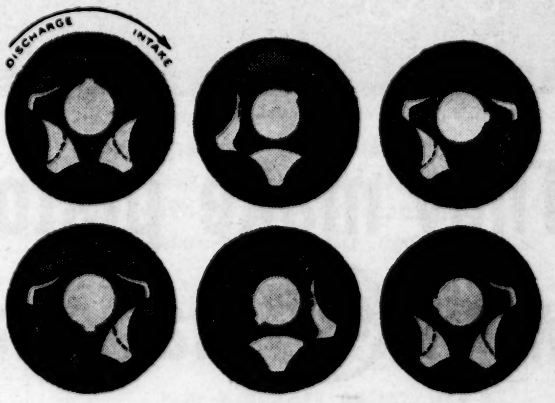
ARTHUR A. NICHOLS

VALUE ANALYSIS REVEALS GEROTOR'S UNIQUE ASSETS

► The rather unusual qualities of the Gerotor pump which have kept it intimately associated with aircraft pumping applications from the days of the earliest superchargers for reciprocating engines, can best be summed up as *inherent adaptability* and *high reliability.*

► **The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.**

► Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See below).



► **Valveless design insures absence of mechanical troubles associated with the operating complexity and service and wear problems inherent in valve construction.**

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

► *Technical data is available and your inquiry is invited. Write:*

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Makers of Zenith Metering Pumps and the Nichols Milling Machine "the miller that uses its head".

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They make piston pins faster for less money with USS National Seamless Mechanical Tubing

It takes plenty of machine time to drill and machine the holes in 6,500,000 piston pins a year. That's what one major auto company* had to do . . . *until* the switch to USS National Seamless Steel Mechanical Tubing. By eliminating the need to drill holes in the bar stock, the company got rid of six chuckers formerly used for drilling, saved time as well as the power they consumed and the space they occupied. ☐ USS National Seamless Tubing has dimensional accuracy. It has no hard or soft spots. It's made by people who know more about seamless tubing than any other manufacturer in the world. You can choose from a complete range of sizes and steel grades. Find out how USS National Seamless Mechanical Tubing can be most effectively applied to your designs. Contact your nearest National Tube Distributor soon.

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United States Steel Supply Division
United States Steel Export Company, New York

FILTER CENTER

▶ **Far Infrared Maser**—Studies of a cyclotron resonance Maser (Craser) which would be tunable over a range of wavelengths and would employ a ruby optical Maser as a pump source indicate the device has considerable promise as a source of electromagnetic radiation in the far infrared, according to Dr. Benjamin Lax, Lincoln Laboratory. Cyclotron resonance Maser has been under study at Lincoln for over a year and will be the topic of a report at a forthcoming meeting on quantum electronics.

▶ **Welded Modules for Missiles**—Size and weight of analog avionic subsystems which may be employed in the Tartar, Mauler and Redeye missiles are being reduced significantly by the use of welded module techniques (AW Aug. 24, 1959, p. 104) at Convair/Pomona. A video amplifier, for example, was cut in size from 49 to 7 cu. in., lightened from 1.9 lb. to 0.29 lb. Mauler and Redeye prototypes employing welded module techniques in their avionic gear were built recently. Same techniques are earmarked for production Tartars.

▶ **Laminar Diodes Due**—Unusual technique of constructing silicon computer diodes which results in devices with a combination of optimum characteristics has been developed by Pacific Semiconductors. Devices, to be trade-named "Laminar" diodes, will be introduced by the company in March at the Institute of Radio Engineers Show. In making the diodes, multiple layers of semiconductor materials are laminated to gold front and back contacts, then surface-passivated and finally welded within the company's standard package to achieve second hermetic seal. Front contact of the diode is imbedded into gold lamination to eliminate front contact failure caused by shock. Typical characteristics of one diode in the line now being manufactured include 4 nanosec. recovery time, 15 picofarads capacitance at zero voltage, forward conductance (at one volt) greater than 500 milliamps and saturation voltage of 75 v.

▶ **Engineer Survey Results in**—Approximately 76% of the nation's electronic engineers are engaged in defense work, according to preliminary returns of survey conducted by Electronic Industries Assn. at the request of the Defense Department. .

▶ **GE Readies Fuel Cell for Marines**—A 45 lb. portable fuel cell, designed to power a small portable surveillance radar used to detect movements on a battlefield, is being readied by General Electric for delivery to the Marine Corps. The fuel cell will take the place of a 55 lb. motor-generator set or 60 lb. battery pack. Fuel cell can operate at full power for a week with only 136 lb. of fuel, GE says.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

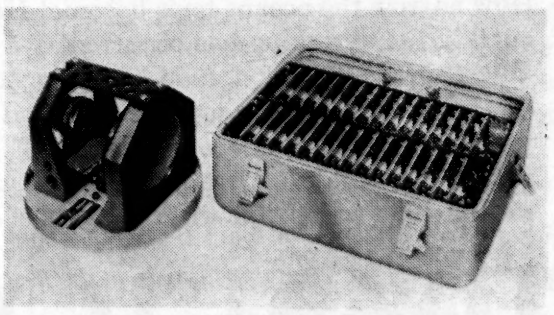
• **Bendix Corp.**, Eclipse-Pioneer Division, $20-million contract from Martin-Orlando, for continued production of inertial guidance systems for Army's Pershing missile.

• **Chrysler Corp.**, $540,486 contract from North American Autonetics Division, for electro-optical auto-collimators to be used with inertial guidance system for Minuteman missile.

• **General Precision**, Kearfott Division, three contracts totaling $3.75 million. One, for $350,000 from Wright Air Development Division, covers development of a solid-state celestial comparator for star detection. Another, for $2.2 million, is for heading and vertical reference systems for use in B-52s, while the third, for $1.2 million from General Electric, covers gyros and accelerometers for Polaris inertial guidance systems.

NEW AVIONIC PRODUCTS

• **Transistorized logarithmic video amplifier,** Type LVT-1, provides a 60 db. dynamic range and a 4 mc. bandwidth. Individual stage feedback permits shaping of transfer characteristics. Amplifiers can be supplied in pairs matched to within 1½ db. Manufacturer:. The W. L. Maxson Corp., 475 Tenth Ave., New York 18, N. Y.



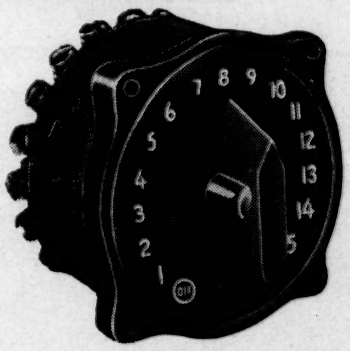
• **Airborne infrared scanner,** Model 12-720, with 30 lead-sulfide detectors, is designed for detecting and measuring radiation from high-speed aircraft, missiles and re-entry vehicles. It can

LEWIS

SELECTOR SWITCHES for

▶ Resistance Thermometers
▶ Thermocouple Thermometers

THERMOCOUPLE SWITCHES



Flanged Cases in 2 inch 3 inch 4 inch dia.

Engineered to give years of service in test work as well as in permanent installations, LEWIS switches have heavy, low-resistance contacts; positive detent action and sturdy terminals for easy wiring.

The cases are splash proof and dust tight, of close fitting bakelite. Husky black-finished aluminum indexing knobs are used to turn the stainless steel shaft supporting the rotating brushes.

RESISTANCE BULB SWITCHES

A companion line of the same construction except that they are fitted with a common-terminal ring for three-wire bulb connections.

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FOR AIRCRAFT RESISTANCE THERMOMETERS

1¼" dia.

Small, sturdy, steel-cased switches 1¼ inches in diameter, 2-9/32 inches total shaft length, one hole mounting with ½-32 NS-2A threaded bushing. Designed especially for connecting two or more resistance temperature detectors to one instrument, now flying in the modern jets.

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Specialists In Temperature Measurement
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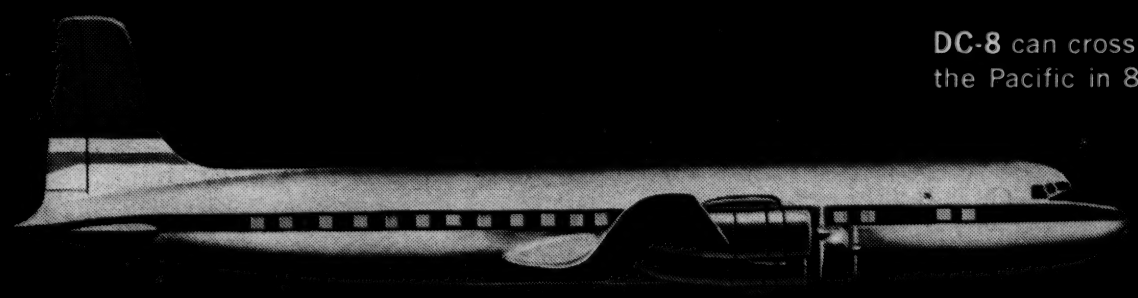
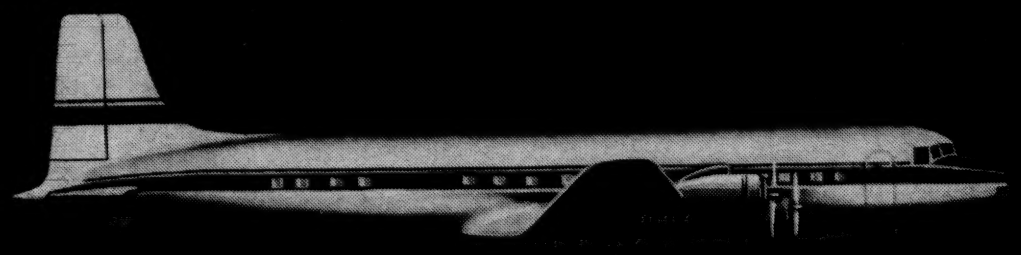
One of a series of advertisements showing the breadth of Douglas experience being devoted to commercial, military and space-exploration projects.

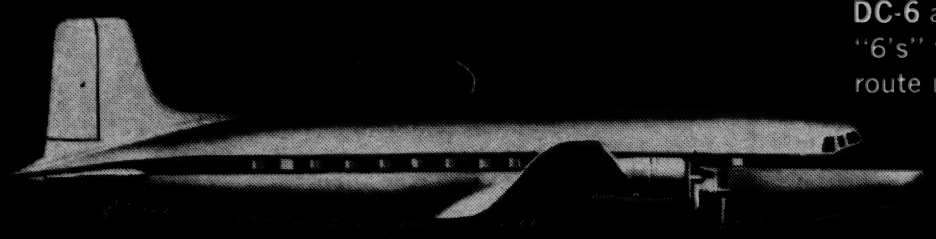
DC-8 can cross the country in 4¾ hours, flies the Pacific in 8½ hours, the Atlantic in 6½.



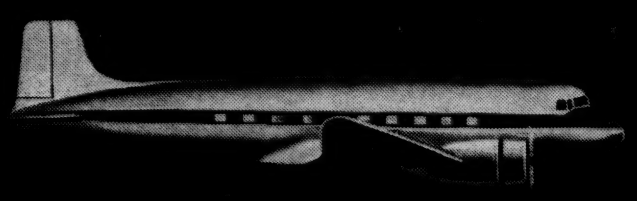
DC-7 was the first airliner to provide scheduled non-stop service coast-to-coast.



DC-6 appeared in 1946. By 1953 the "6's" were flying more than 500,000 route miles daily for 27 airlines.



DC-4 pioneered transocean flight. This 4-engine aircraft carried the brunt of the Berlin airlift.



DC-3 — Douglas built almost 11,000 of these famous 21-passenger airliners. Thousands are still in service.

Five big steps to a smaller world

How narrow the oceans have become! How small the world! And how quickly the shrinking has occurred!

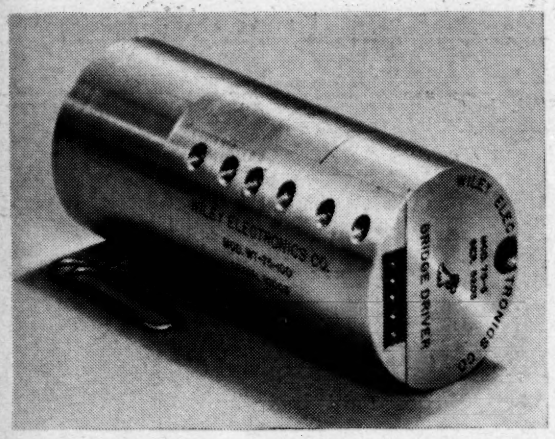
Within a generation, man has stopped wondering if he would ever fly, and now asks how soon he will land on the moon.

Douglas, builder of the 5 great "DC" airliners that did so much to shrink the world you live in, is now at work on the great rockets and rocket ships which will shrink the solar system.

DOUGLAS

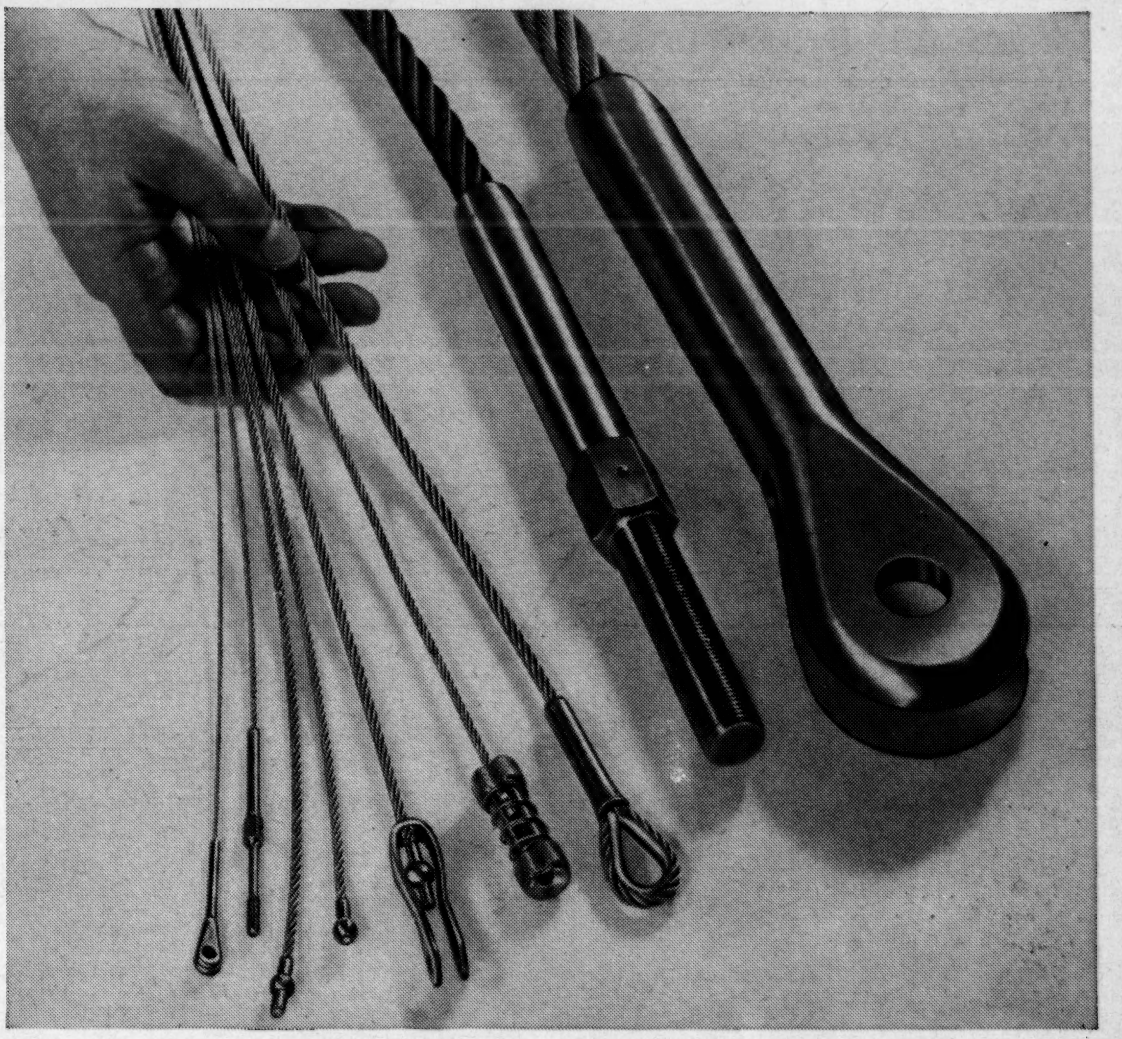
MISSILE AND SPACE SYSTEMS • MILITARY AIRCRAFT • DC-8 JETLINERS • TRANSPORT AIRCRAFT • ANTI-SUBMARINE SYSTEMS • AIRCOMB® • GROUND SUPPORT EQUIPMENT

simultaneously detect and measure radiation from variety of targets over a wide range of temperatures. The scanning head, measuring 9½ in. dia. and 7 in. high, weighs 15 lb. It can be scanned at rates up to 600 degrees per sec. Output from 30 detectors can be recorded or fed to an intensity-modulated oscilloscope with a high-speed step generator to give a pictorial display of scanned area. Specification sheet 14-310, available upon request, gives application data. Manufacturer: Barnes Engineering Co., 30 Commerce Road, Stamford, Conn.



• **Subminiature telemetry transmitter,** designed for short-range operation in severe environment, can transmit while rotating at speeds in excess of 33,000 rpm., vibrating under a 30g acceleration at frequencies up to 2,000 cps., while subjected to temperature of 100C, according to manufacturer. The FM transmitter, including battery, is contained in package only 1¼ in. dia. x 3 in. long. Broadcast range is more than 20 ft. Manufacturer: Wiley Electronics Co., 2045 West Cheryl Drive, Phoenix, Ariz.

• **Miniature high-current relay** (contactor), Model DH-7B, provides 3PDT configuration with contacts rated 50 amp. at 115/208 v. Contactor, hermetically sealed in can 2⅜ in. diameter x 2⅞ in. high, weighs 12 oz. Unit is undergoing military qualification for MIL-R-6106B. Manufacturer: The Hartman Electrical Manufacturing Co., 175 N. Diamond St., Mansfield, Ohio.



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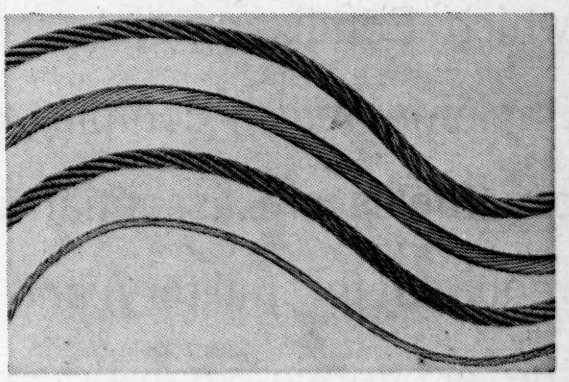
Tru-Loc aircraft fittings are guaranteed three ways—they conform to specified dimensions; they hold to the minimum rated breaking strengths of the cables to which they are swaged; and they are free from deformation, splits and internal cracks. With Tru-Loc swaged fittings you also get:

Widest range of sizes • Tru-Loc fittings are available for cables ranging from 1/16″ to 2½″ diameters.

Types for every application • Sleeve-type, ball-type, ball-with-strap, center-pull loop fittings, "*Quickies*" for instant connect and disconnect—all of these fittings were originated by American Chain & Cable Company, Inc. Special fittings can be designed as required.

"NO-MAG" CABLES GIVE BETTER CORROSION-RESISTANCE THAN STAINLESS STEEL
"No-Mag" cable is non-magnetic, won't interfere with instrument operation. In corrosion-resistance and thermal characteristics, it is superior to standard stainless steel. "No-Mag" aircraft cables also offer high fatigue and abrasion resistance, are available in a complete range of sizes in all the standard aircraft constructions.



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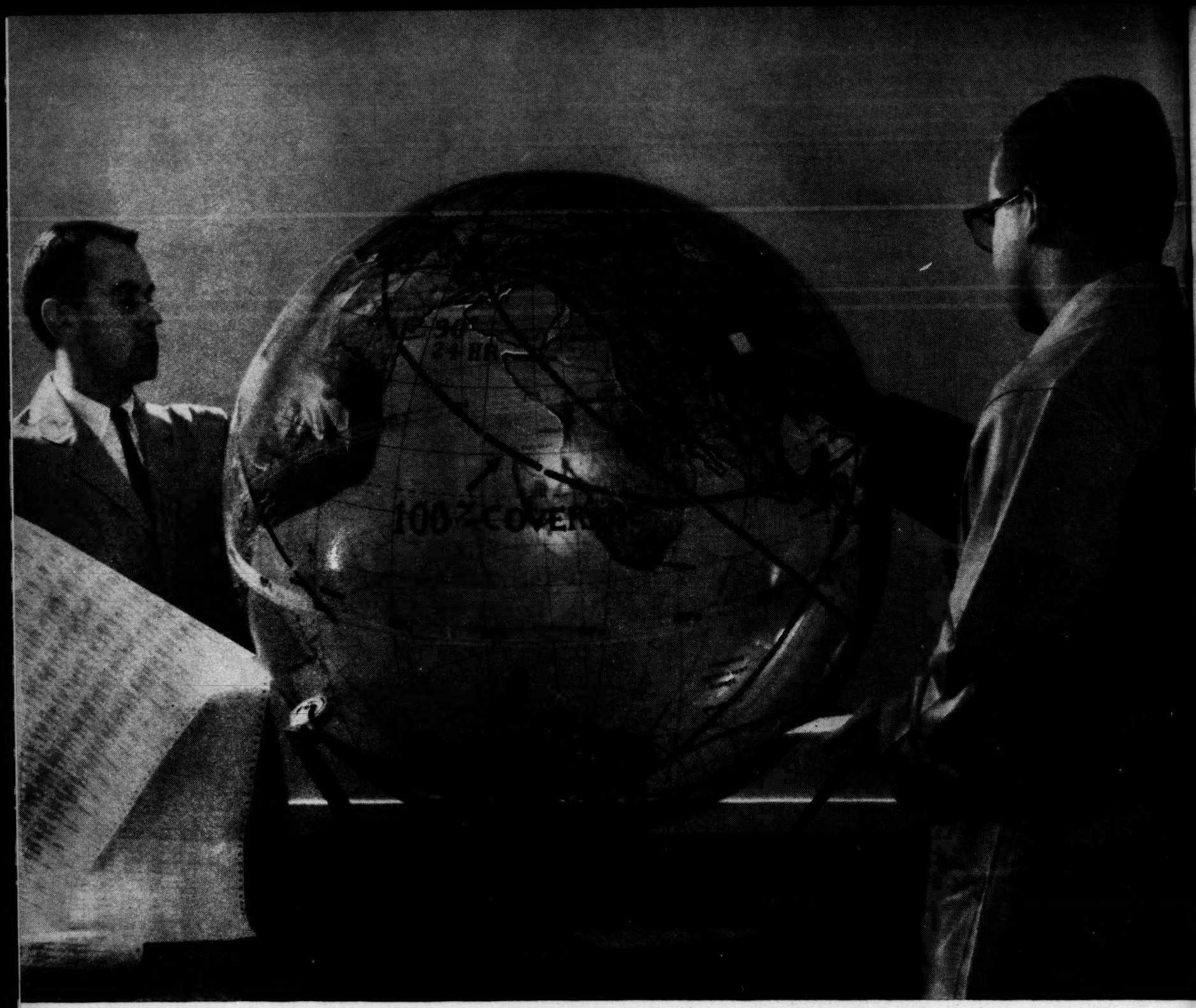


Three satellite relays in synchronous 90° orbits will provide continuous coverage of North America and polar regions from a ground station located in the central United States.

TIMETABLES FOR SATELLITE RELAYS are computer print-outs by which Bendix predicts, second-by-second, when communications could be implemented in complex configurations of earth and space terminals. Such timetables are essential to the selection of orbits and number of satellites required for military and civilian systems. They also provide key data for the economic analysis and operational control of satellite communication systems which offer career opportunities for better scientists and engineers.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

THE Bendix CORPORATION

Sole-Source Defense Buying Criticized

Washington—Senate Small Business Committee is making sole-source purchasing the major target of its perennial criticism of military procurement.

In the past, the committee's primary objective has been more advertised bidding and less negotiated contracting in defense buying as the way to extend the participation of small business. In its latest report, the committee explained that it does not "fully" accept Defense Department's explanation that advanced technology has forced negotiated contracting with large firms, but has decided to concentrate on "the more basic question of the degree of competition actually solicited and evaluated in defense purchasing."

In Fiscal 1960, the report noted, sole-source negotiated procurements accounted for $15.4 billion of Defense Department spending, while negotiated procurements with price competition accounted for only $850 million. Contracts let by formal advertising during the year totaled $3.2 billion.

Three Highlights

The three highlights of the committee's report, based on studies by the military subcommittee headed by Sen. George Smathers (D.-Fla.), were:

• **Replenishment of spare parts.** The report said that this is one of the most promising areas for increasing competition. It was critical of the extensive practice of "open end" contracts under which the military services agree to buy an unknown quantity of replenishment spares from the prime contractor and negotiate specific contracts at the time the spares are required. "Experience shows that savings averaging 30% to 40% invariably followed each time spare parts which had been purchased on a 'sole source' basis were exposed to competition," the report said.

• **Two-step formal advertising.** This procedure, developed by Air Force in response to congressional demands for more advertised bid contracting, was discredited by the committee. Under this procedure, Air Force obtains technical proposals from several companies and then formulates a specific requirement on which sealed bids are solicited. This "may involve unwarranted appropriation of technical data from those companies initially submitting technical proposals," the report commented.

"Simple negotiated procurement, adequately regulated, would appear to be appropriate and fairer to companies submitting these proposals. Under the two-step procedure, it is not inconceivable that an excellent proposal submitted by one company could be utilized by the Air Force in adopting the final invitation for bid. That company would then find itself shorn of its private 'expertise' and in no better position than its competitors, who obviously initially displayed less technical competence or imagination.

"An alternative solution would be for the military departments to solicit technical proposals and pay for them in proportion to the contribution they make to the acceptable requirement. This would obviate the necessity of having government personnel spend months, and sometimes years, in drafting specifications. It would also, even more than the two-step procedure, offer the department a free hand at formally advertising for the ultimate requirement," the report said.

• **Contractor drawings.** The report criticized the military departments for failing to obtain detailed engineering drawings from sole-source suppliers, prepared at government expense, so they could "capitalize on the savings inherent in competitive procurement" in follow-on orders.

In a statement of "supplemental views," Sen. Andrew Schoeppel (R.-Kan.) declared that although the military services must take advantage of price competition "even more importantly they are required to secure equipment on a schedule that embodies the latest advances of American science and industry."

Realistic Planning

He noted that "any realistic mobilization planning should place major emphasis upon the larger and fully staffed industrial firms to coordinate procurement activities." He pointed out that a small business generally no longer falls into the classification of "small business" when it has developed "enough personnel to be able to cope with the many specialized problems that are inherent in the production of military materiel. . . ."

On the matter of contractor-furnished drawings, Schoeppel observed that in a field of fast-changing technology "it is virtually impossible to maintain any set of drawings and specifications in such a form that will provide all essential information." In addition, he said, "there is a vast amount of knowledge and background understanding which cannot be incorporated into any drawing."

On procurement of replenishment spares, Schoeppel observed that "by placing the responsibility . . . with the contractor who originally developed the equipment, the government often avails itself of inspection, purchasing and supply supervision on an advantageous basis." He qualified that "however, if it is possible to so standardize the requirements that a sealed-bid advertised procurement will accomplish the desired result, such a course is the preferred method of procurement."

Closer Liaison Urged For Defense, State

Washington—Closer cooperation between the Departments of State and Defense was one of several key changes recommended to improve the national security policy process by Sen. Henry M. Jackson (D.-Wash.), chairman of the Senate Subcommittee on National Policy Machinery.

In a subcommittee staff study on ways to strengthen the position of the Secretary of State as the President's top adviser on foreign policy and national security, Sen. Jackson said: "What is needed is action to shore up the traditional means of exercising executive power," rather than radical reorganizational change.

Sen. Jackson also said much of the effectiveness of the Secretary of State depends upon his being in Washington to advise the President, lead his department and consult with the Congress.

Other suggestions recommended:

• **Eliminate outdated** committees. A very high percentage of committees serve no useful purpose or they live on long after their usefulness has ended.

• **Increase job exchange** arrangements between State and Defense and other national security agencies.

• **Make more aggressive** efforts to give advanced training to civilian officials in State and Defense.

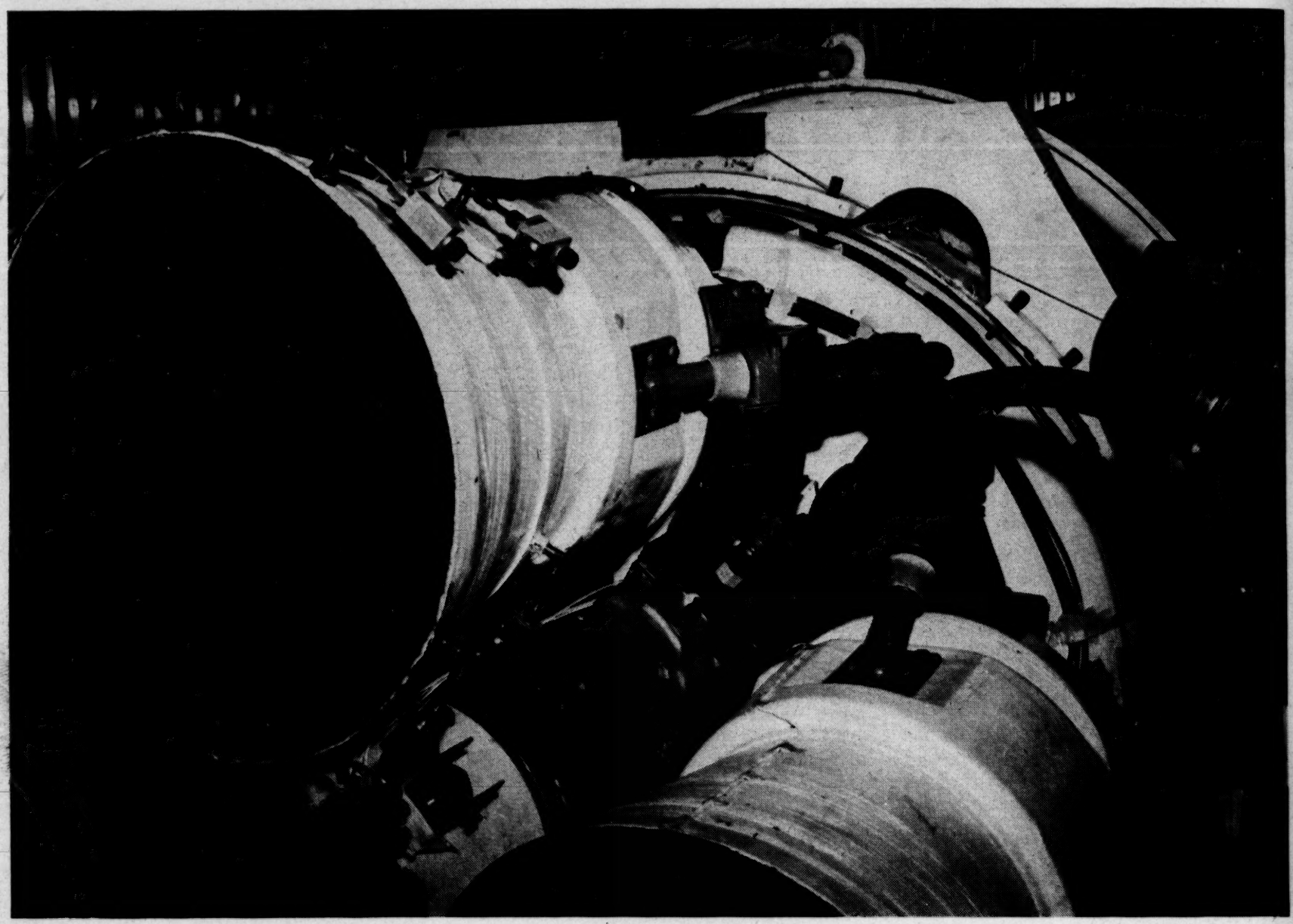
• **Get more top level** military and technical staff competence in State.

• **Seek first-rate staffing** of the Policy Planning Staff for basic political-strategic advice to the Secretary.

• **Make greater use** of outside help to the State Department from universities and other study centers.

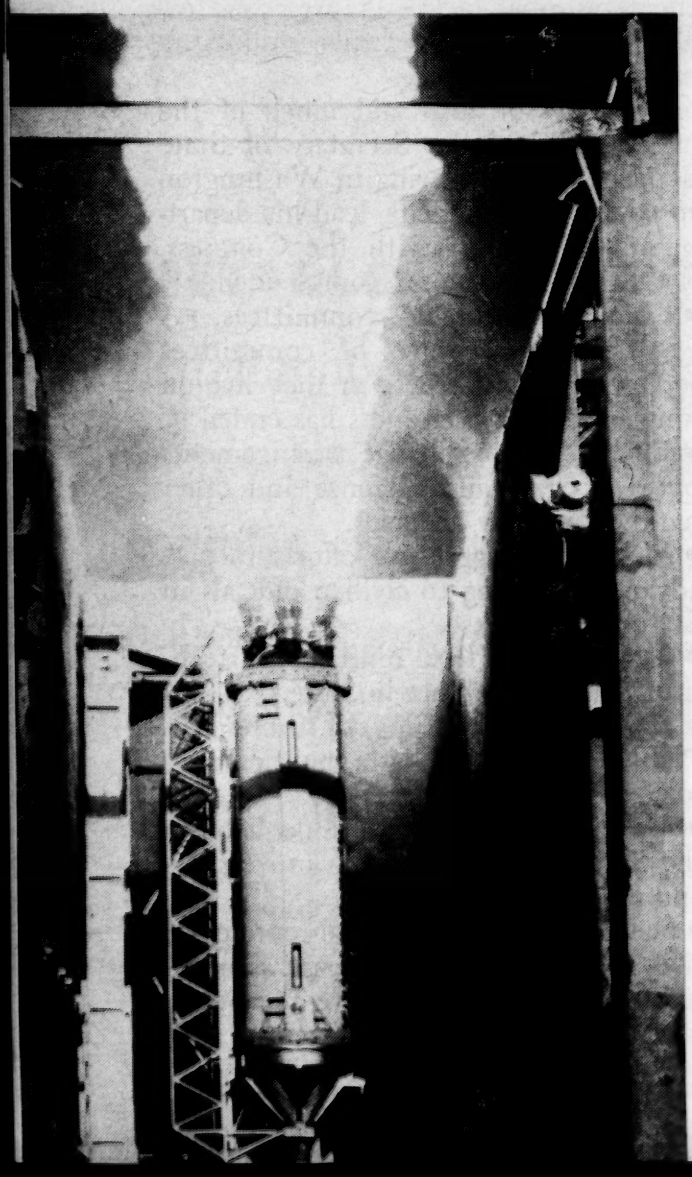
• **Seek a "reserve"** of special representatives for quick and flexible use as negotiating needs arise to relieve the Secretary of State of part of his travel and negotiating burdens.

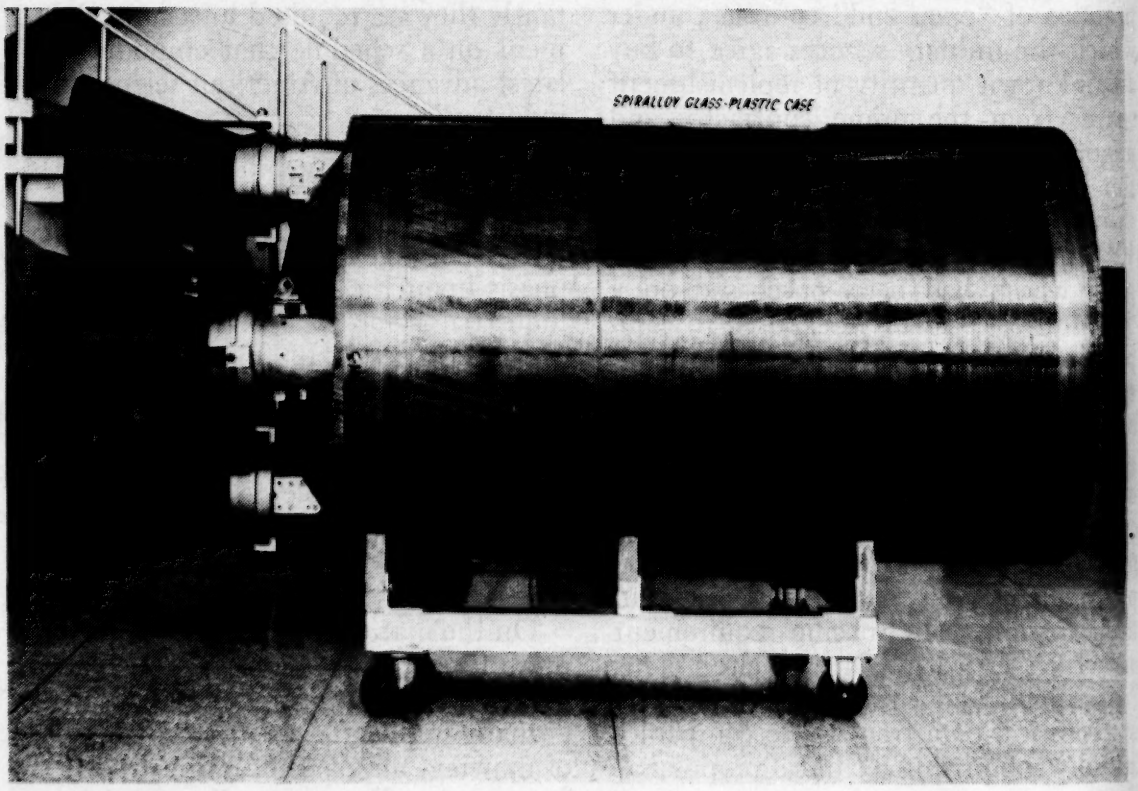
MISSILE ENGINEERING



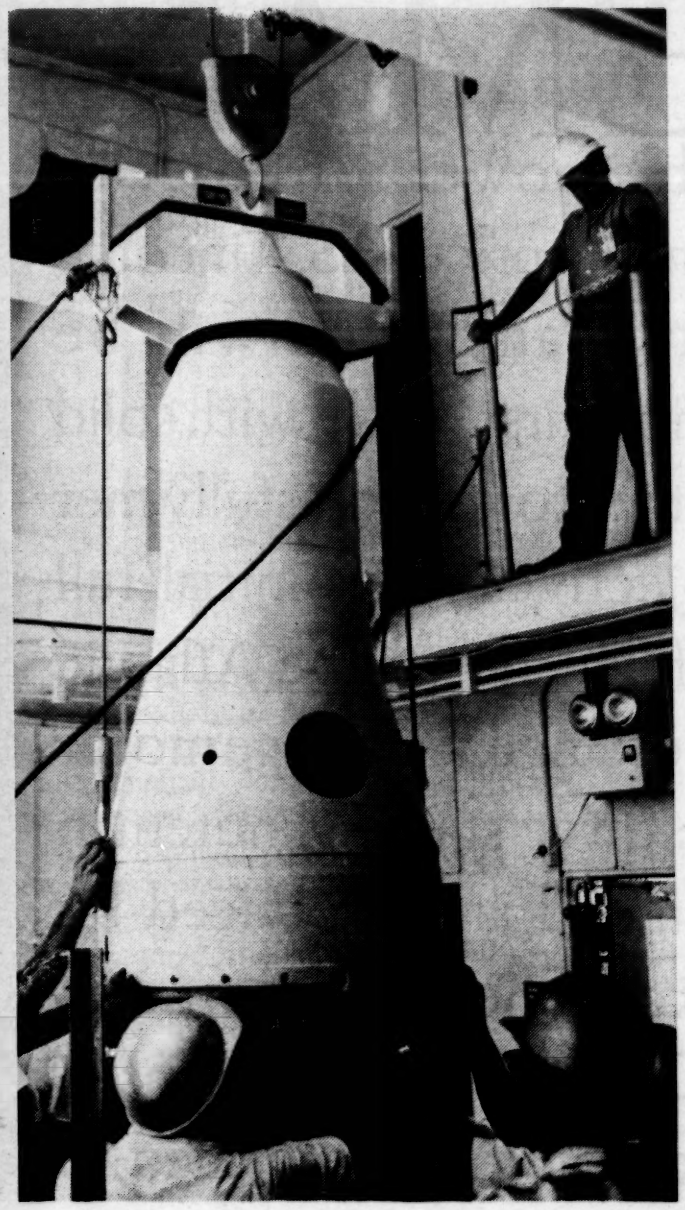
Aerojet-General's second-stage engine has nozzle actuators (piston-like units at nozzle throats), nozzle control unit (two boxes between nozzles) and guidance and control cabling (black hose). Autonetics guidance and control system sends steering commands to nozzle control unit through cable; control unit interpolates steering data and then activates hydraulic power system to move actuators. Aerojet's flexible connector and seal is of the bellows type. Engine develops about 55,000 lb. thrust (AW Feb. 6, p. 28).

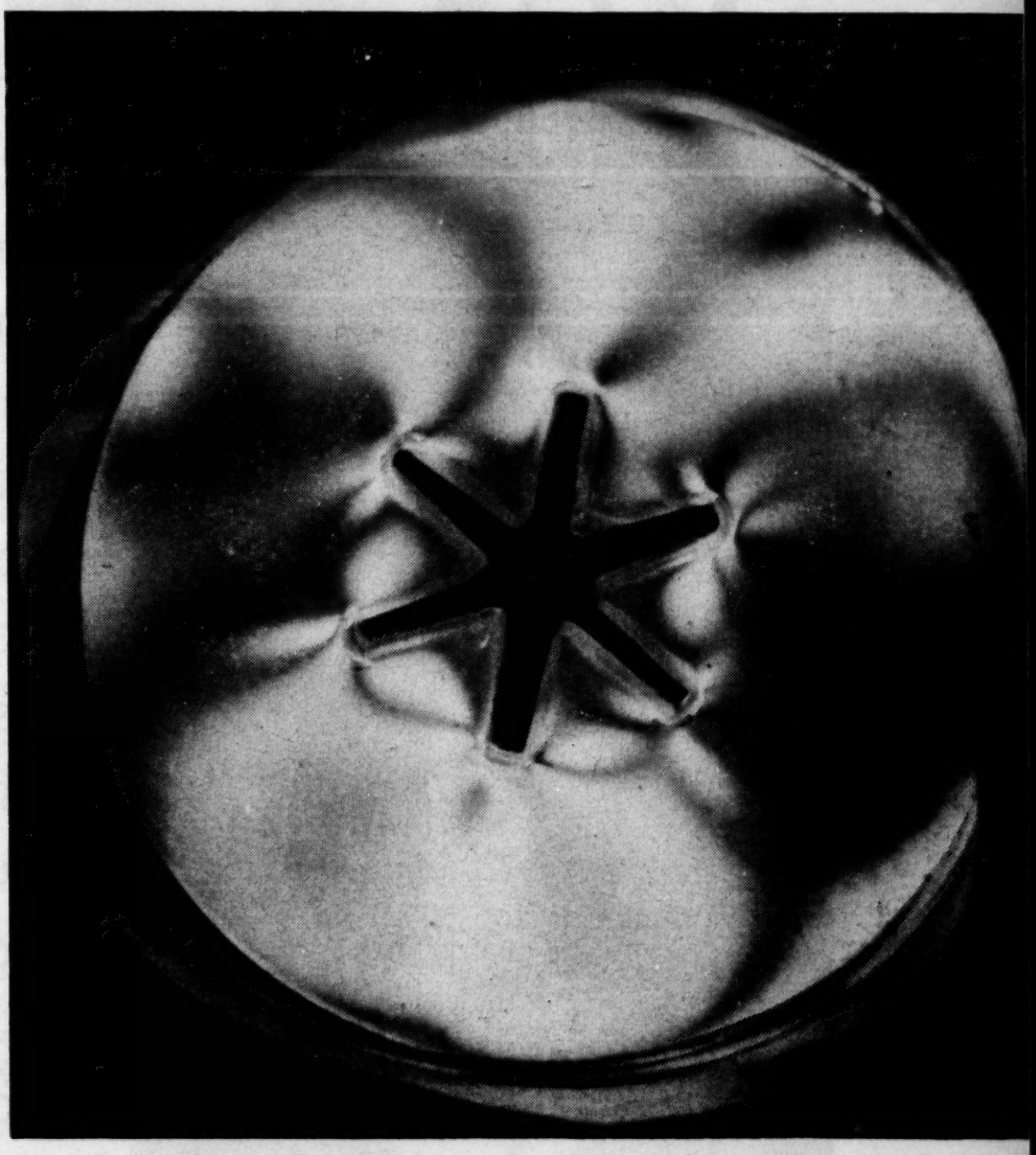
Minuteman Subsystems Teste





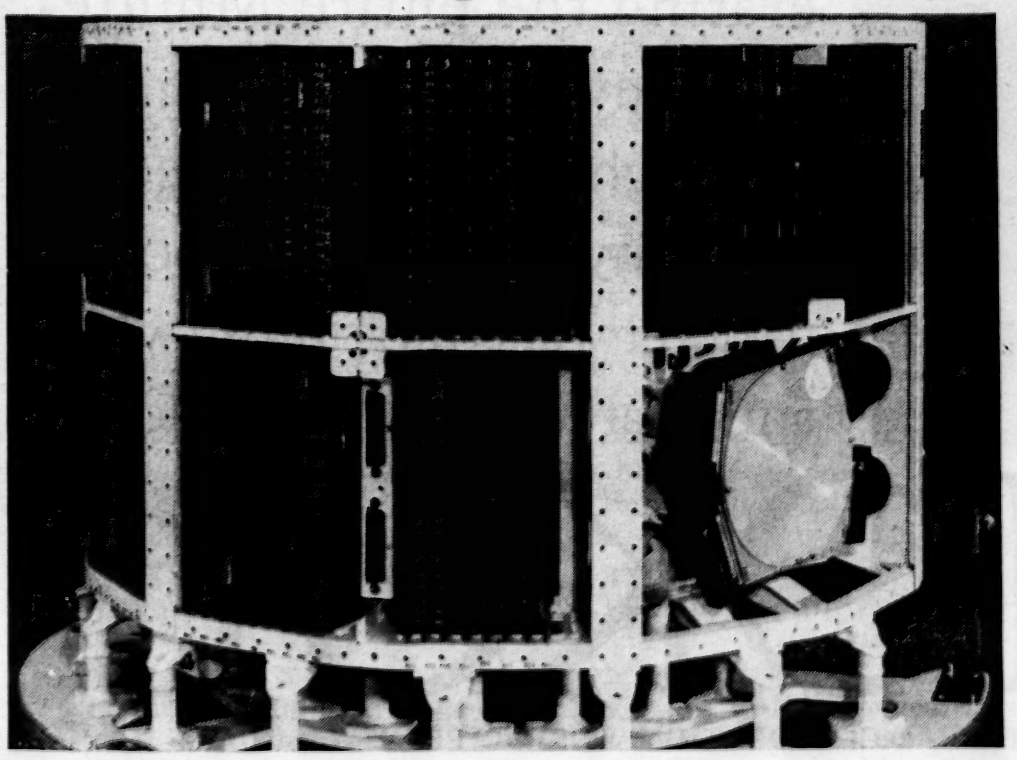
Thiokol first-stage engine (left) is static-fired at Brigham City, Utah, test facility in inverted position. Engine develops about 170,000 lb. thrust. Hercules third stage (above), generating 35,000 lb. thrust, is made of filament-wound resin-bonded glass fiber. For flexible connectors and seals, both Thiokol and Hercules employ O-ring seals which move within a parentheses-shaped ( ) section of the exhaust tubes.



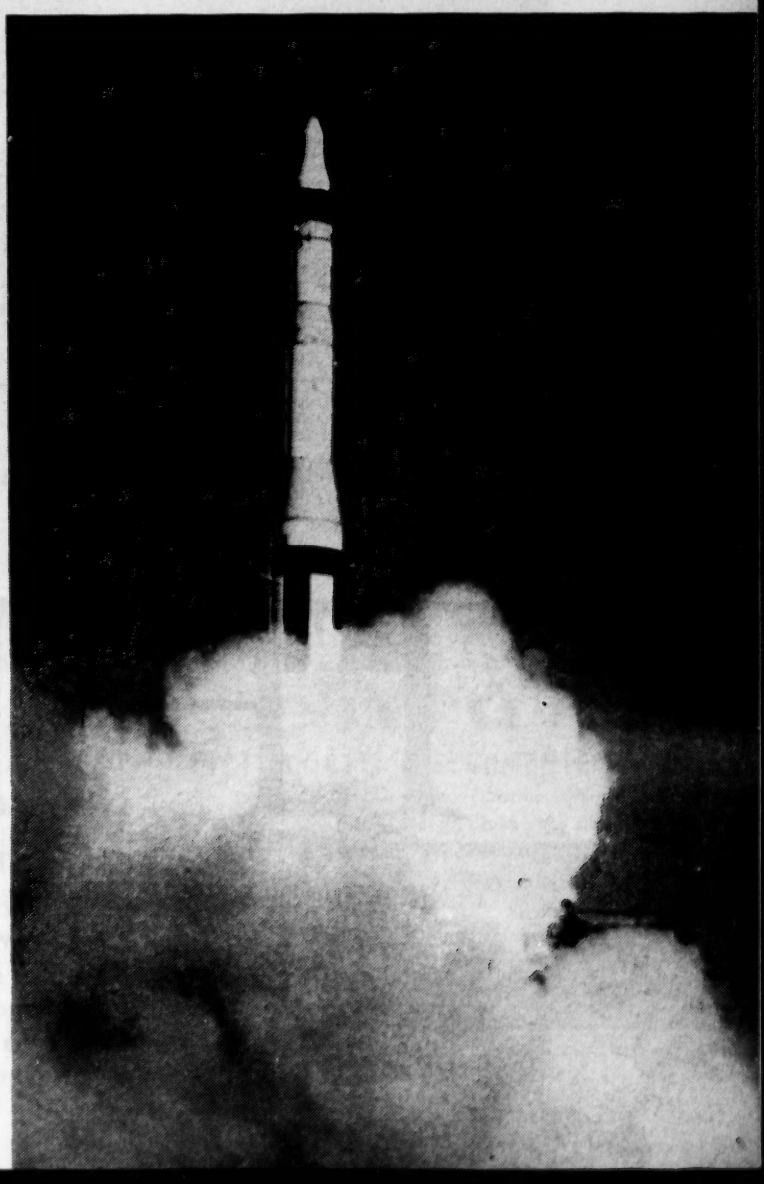


Avco Mark V re-entry vehicle (left) is fitted to Minuteman. Large black circle is flush-mounted antenna window; smaller circle is telemetry antenna window. Propellant configuration specimen (right), 6 in. dia., 1 in. deep, for first-stage engine is seen through a polarized light viewer. Thiokol developed this technique to reveal stress and strain patterns in the propellant before casting full-scale motors. Propellant (Thiokol: polybutadiene acrylic acid; Aerojet: polyurethane, Hercules: nitrocellulose-nitroglycerin) is cast in star configuration.

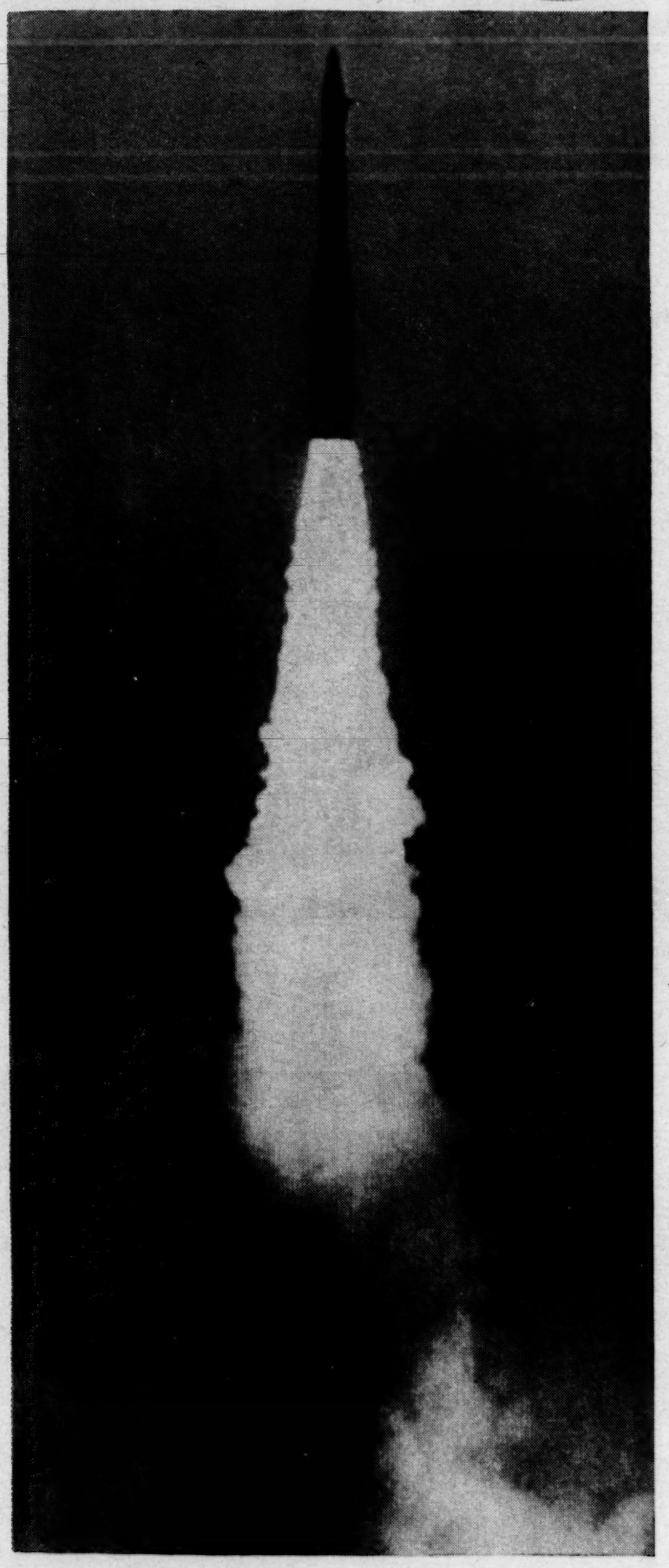
te in First Free-Flight Launch



Autonetics guidance and control system uses full-transistorized, serial-mode digital computer with rotating magnetic disk type memory unit that has about 75,000-bit capacity and is air-suspended. Computer, operating from punched tape, solves guidance and flight control equations, generates steering commands for nozzle vectoring, and controls staging and thrust termination. Minuteman (right) lifts from pad on Feb. 1.



MINUTEMAN



Reliable power for peace at reasonable price, U.S. Air Force Minuteman which will be America's first ICBM with solid rocket motors successfully met its objectives in its initial full scale flight down the Atlantic Missile Range. First stage motor of the three stage Minuteman is designed and produced by Thiokol Chemical Corporation. During early test phases, Thiokol motors performed so superbly the original schedule of preliminary firings was cut to less than half, greatly accelerating the entire Minuteman development program. Through Thiokol engineered reliability, the nation's power to deter war is moving up while anticipated costs come down.

THIOKOL

Thiokol® CHEMICAL CORPORATION, BRISTOL, PENNSYLVANIA

Rocket Operations Center: Ogden, Utah • Minuteman Engines developed and supplied by Utah Division, will be produced by Wasatch Division.

Associate Prime Contractors: Thiokol Chemical Corporation, first stage; Aerojet-General Corporation, second stage; Hercules Powder Company, third stage; Autonetics Division North American Aviation, guidance and control system; AVCO, re-entry vehicle; Boeing Airplane Company, assembly and test.

ENGINEERS, SCIENTISTS: Creativity is always welcome. If you qualify, there may be a place for you on the Thiokol team.

Consumable Case Design May Add To Solid Propellant ICBM Range

Salt Lake City—Consumable case solid propellant first stage should be able to add 700 mi. to ICBM ranges for a given weight, and consumable case upper stages should add even more, according to a design study by A. N. Baxter of Space Technology Laboratories reported at the Solid Propellant Rocket Conference of the American Rocket Society.

The chief advantage of the consumable case design is that, unlike conventional solid propellant rockets, it does not have to accelerate the full weight of its case during all of its burning time. Baxter's study included a comparative analysis of two rockets weighing 50,000 lb., one a conventional solid propellant design and the other the proposed consumable case rocket.

The consumable case rocket consists of an end-burning cylindrical solid propellant grain pressed between a nozzle assembly and a front end dome by six lead screws or threaded case rods. The case rods advance the nozzle assembly to keep pace with the burning surface.

At burnout the front end dome and the nozzle assembly are in contact. The space between the burning surface and the converging nozzle walls forms a much smaller combustion chamber than that of a conventional solid rocket.

Ablative Casing

The grain is encased in a sleeve of ablative material which helps resist the tendency of the grain to be extruded radially by the compressive force between the combustion chamber and the front-end dome. It also helps to seal the gap between the nozzle assembly and the grain and as it is fed into the chamber it acts as a film coolant for the nozzle assembly. The threaded case rods advancing the nozzle with the burning surface are activated by a turbine driven by hot gases tapped from the combustion chamber through a small central perforation in the grain.

Baxter said the consumable case rocket offers a mass ratio of 30, a 40% superiority in burnout velocity, reduction of case weight by 50%, restart capability, near 100% loading density, and in the turbine exhaust a source of auxiliary power and thrust for roll control.

He pointed out that since conventional internal-burning solid propellant rocket cases must be designed to meet hoop stresses, they are about 100% overstrength with respect to axial stress. The use of an end-burning grain in the consumable case rocket eliminates nearly all hoop stress outside the nozzle assembly. The threaded case rods can be designed strictly to axial loads.

A honeycomb structure is to be placed in the combustion chamber to support the weight of the propellant when the missile is erect. This prevents propellant slump or cold flow and relieves buckling loads upon the case rods. The honeycomb would be shattered at ignition and spewed out the nozzle. Baxter said the fragments of the structure would actually assist the start by maintaining a high chamber pressure as they exit through the nozzle throat.

One of the most difficult problems foreseen in the development of the consumable case rocket is that of sealing the line of contact between nozzle and propellant against hot combustion gases under 700 psi. chamber pressure. The film of molten case material on the nozzle walls is supposed to remain intact until it passes through the nozzle throat. Baxter has designed a number of seals to hold the ablative case tight against the grain as the nozzle moves up its length. He showed one design based on a serrated flap seal-held in position by an inflatable bag full of a pressurized lubricant. The lubricant is also laid on the outside of the case just before it is swallowed by the nozzle assembly to reduce friction and help seal the interface between the case and the serrated flap.

For the 150,000-lb. to 200,000-lb. thrust rocket evaluated, the ablative case would weigh 312 lb. because it puckers as it approaches the nozzle throat. The thickness of the case would rise from 0.1 in. to 0.2 in. in the combustion chamber.

Case Rod Designs

The six case rods were designed to withstand:

- **Axial tension of 3 million lb.** produced by chamber pressure upon the nozzle.
- **Acceleration of 10g** along the line of flight.
- **Buckling loads produced** by a 20,000-lb. upper stage with the missile standing erect.
- **Bending moment** of about 1 million in./lb. by aerodynamic and control loads.

As the nozzle assembly moves up the case rods, small shaped charges inside the rods are detonated to jettison the part of each rod that has been passed. The charges would be spaced at 1-ft. intervals.

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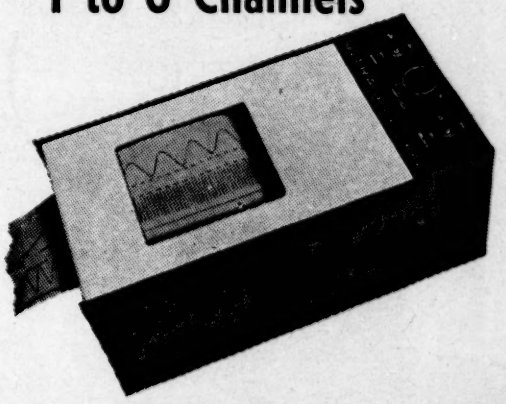

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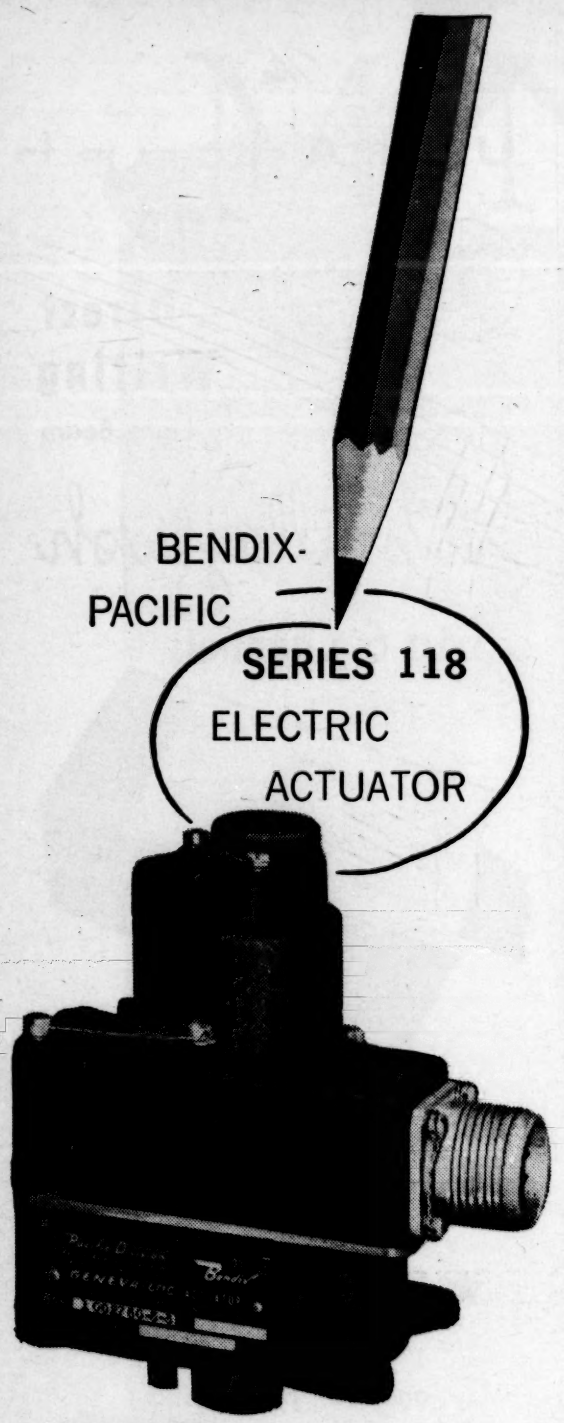

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Howard M. Segal of Aerojet-General Corp. describe a rapid method of evaluating and designing spherical solid propellant rockets with "melon-slice" internal burning chamber design.

Segal said the design of spherical solid propellant rockets can be optimized only by making the grain and the chamber mutually symmetrical. The basic advantage of the spherical rocket is that a sphere is the most efficient shape for a pressure vessel. For a given diameter, the case thickness of a spherical solid rocket can be half that of a cylindrical rocket. However, in most of those built to date, the amount of insulation has had to be relatively higher than in cylindrical rockets because it has been difficult to get the mutual symmetry necessary to prevent the flame front from reaching the chamber wall before the web of propellant is completely consumed.

Segal shows that the melon-slice grain design requires less insulation than one with either a spherical or cylindrical star-shaped chamber. He pointed out that this design can also be used in conventional cylindrical rockets to increase propellant loading and mass fraction and reduce insulation weight by using the propellant web to protect the fore and aft closures.

Phenolic Resins Used In Space Applications

The development of improved single component phenolic resins has enabled Westinghouse Micarto Division scientists to make glass fabric reinforced laminates suitable for rocket nozzle liners, re-entry heat shields and airframe structural parts.

The new phenolic binder laminates reportedly show a higher flexural strength at all temperatures than do silicone binder laminates and have thermal and erosion resistance that nearly equals that of silicone binder laminates.

Prior to Westinghouse's developments, the most significant barrier to successful formation of phenolic resin laminates more than $\frac{1}{8}$-in. thick was the appearance of gas-formed blisters in the laminates during the post-curing process. The new resin, which has one component instead of the usual two, resists chemical breakdown under the heat of the post-curing process and therefore retards the formation of destructive gases.

Westinghouse has tested the phenolic resin in laminates reinforced with glass, quartz and leached glass. Of these, the glass reinforced laminates displayed the lowest weight loss but the quartz and leached glass laminates exhibited the least erosion in oxyacetylene burn-through tests. Actual erosion rate was about one-fourth that of stainless steel. Compared with other laminates, the phenolic resin materials performed well over the range of tests.

Air Force to Establish Communications Unit

Washington—Air Force Communications Service will be established July 1 to operate and maintain all Air Force point-to-point and air-to-ground telecommunications on a global basis, except for systems required for weapons control.

The new command, with headquarters at Scott AFB, Ill., will replace the Airways Air Communications Service (AACS), which operates about one-third of the USAF's present communications facilities and all its navigation and traffic control services. AFCS also will assume similar responsibilities for another large portion of USAF facilities, such as base communications, which now are operated by a separate organization at each base.

The new organization is expected to provide a more effective system at considerable savings in manpower and dollars, according to Gen. Thomas D. White, Air Force chief of staff. It will report directly to the chief of staff.

Transfer of responsibility will take place gradually, beginning with the Military Air Transport Service, under which the AACS now operates, and being followed by the major operating commands. Question of which facilities will be retained by operating commands for weapons control is under study.

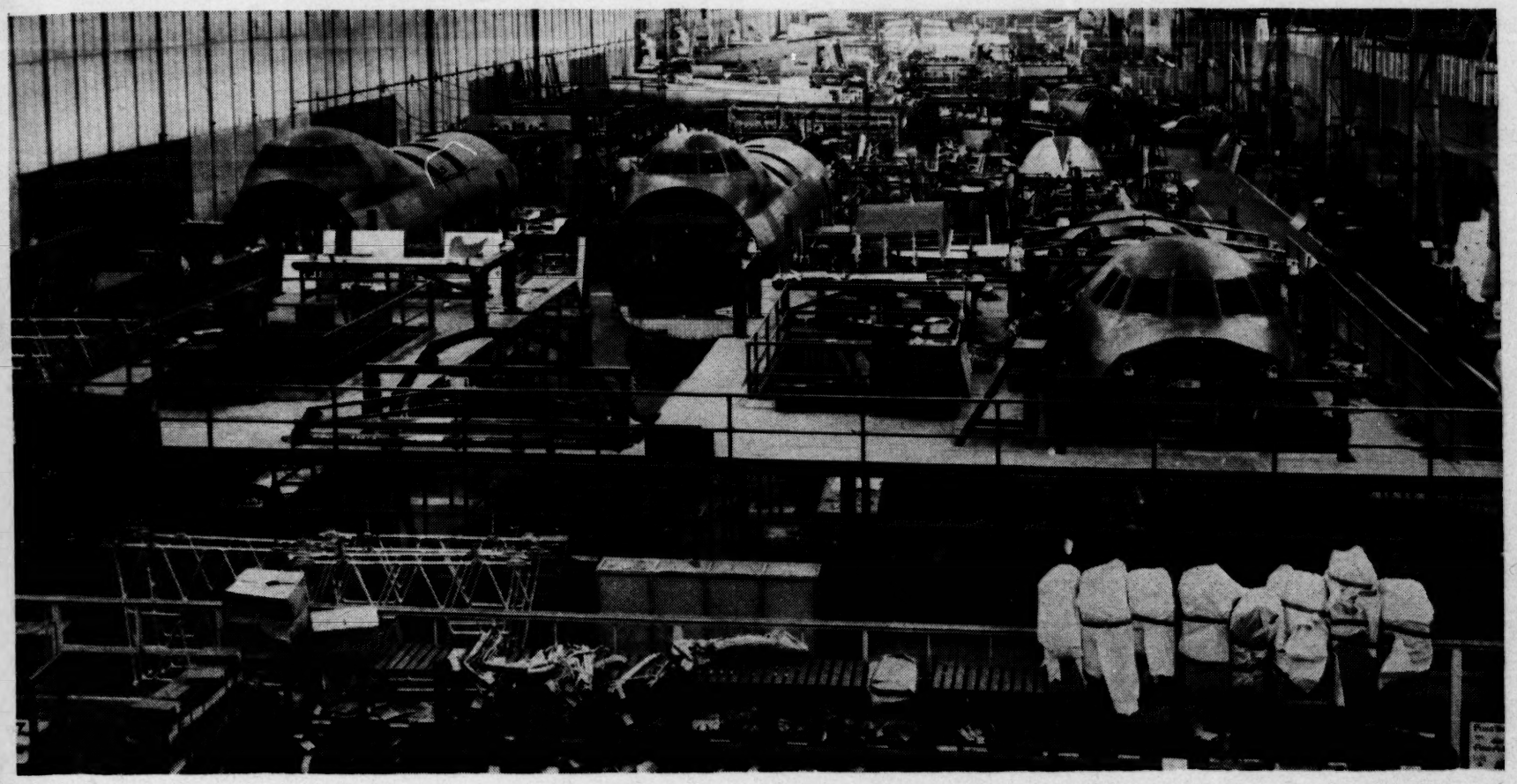
Nike Zeus Computer Readied in Atlantic

New York—First Nike Zeus digital computer has been shipped to Ascension Island in the South Atlantic to collect and process data on the re-entry radar characteristics of missiles launched from Cape Canaveral. The computer—part of the Army-Western Electric anti-missile-missile system—will be used in conjunction with the Western Electric Nike Zeus target-track radar.

Built by Bell Telephone Laboratories (BTL), Whippany, N. J., for Western Electric, the computer was constructed from complete information furnished by a general purpose IBM 704 computer, especially programed by BTL engineers. The IBM computer provided wiring diagrams, assembly instructions and parts lists for the entire logic network, consisting of 47 subassemblies.

In developing the Nike Zeus computer, BTL engineers made use of an automatic process called BLADES (Bell Laboratories Automatic Design System) in the programing of the IBM 704 (AW Feb. 6, p. 95).

AERONAUTICAL ENGINEERING



ARGOSY fuselage unit assembly jigs are shown above with bi-level working platforms. Tubular reinforced plastic jigs are in foreground.

Argosy Assembly Time Reduced by 25%

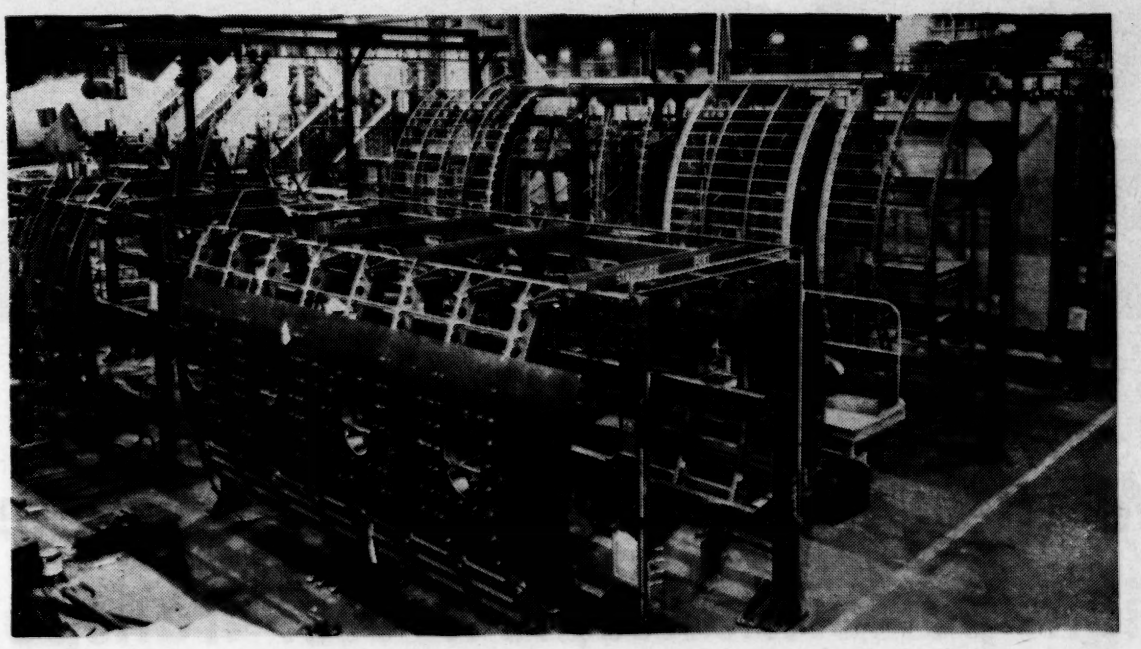
By John Tunstall

London—A 25% gain in assembly time is claimed by Armstrong-Whitworth in its current civil and military AW 650 and 660 freighter programs by introduction of a new jigging strategy based on tubular glass fiber jigs and the maximum use of self-jigging subassemblies.

"We are building the Argosy like a ship," R. A. Courtman, senior production executive of Armstrong-Whitworth, told AVIATION WEEK. First the keel is laid and the seat rails fixed. Then the rest of the fuselage is jigged from the seat rails using low-cost lightweight tubular glass fiber jigs.

As with the first 10 freighters, the company is expecting to authorize shortly the production of an additional 10 aircraft without any orders on the books. Seven of the first civil batch have been ordered by Riddle Airlines; the other three are still uncommitted. Negotiations for the sale of these aircraft to British European Airways are believed to be under way.

Accessibility and the maximum use of prefabricated, self-jigging subassemblies is the key point in Armstrong-Whitworth's strategy. The keel is laid in resin-bonded laminated plastic sheeted cradles, the main jigging points being the end-frames, main floor rails, wing pickup points and the frame joints. Obstruction from external steel super-



SUBASSEMBLY fabrication jigs for fuselage panels show method of frame location at critical points (above). First stage of fuselage assembly (below) shows prefabricated keel on plastic cradles with seat rails secured. Glass fiber triangulated tubular jigs locate seat rails and secure critical frame locations.

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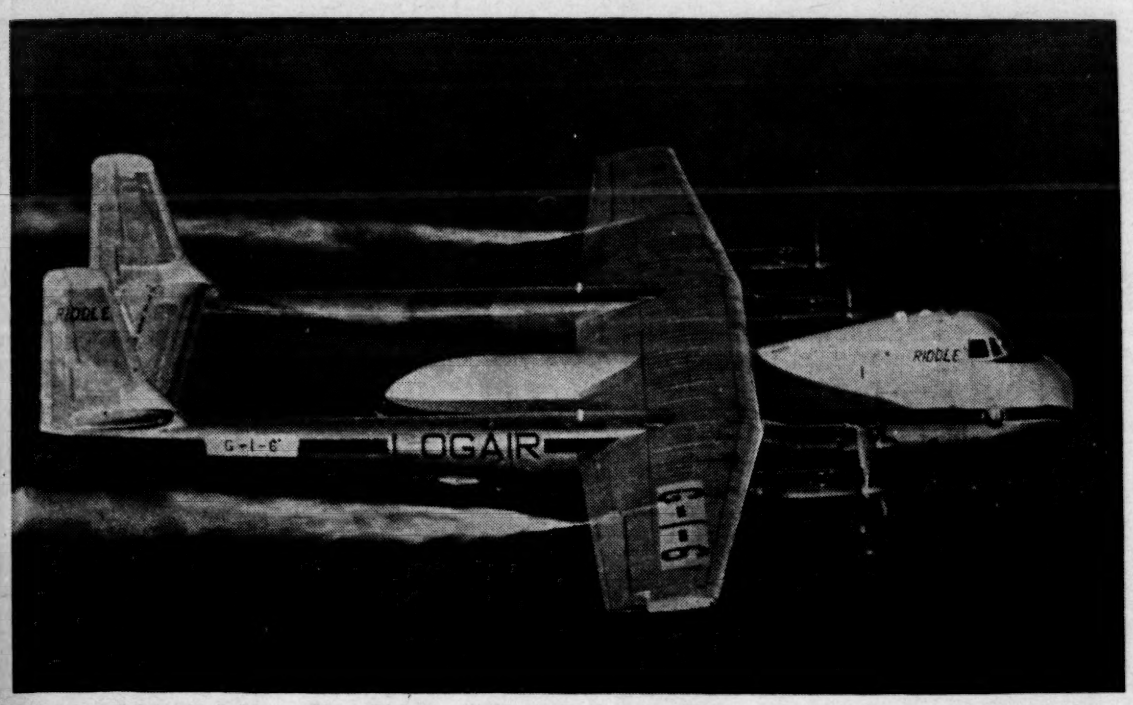

FIRST ARGOSY delivered to Riddle Airlines is shown jettisoning fuel during pre-delivery flight trials. Note fully-feathered starboard outer engine.

structures normal to fuselage assembly jigs virtually has been eliminated, the wing pickup points and the front and rear door frames being the only points in the whole of the 47-ft.-long fuselage which are located by external structure.

The glass fiber jigs which tie up the critical frame locations have been designed so that operators can walk through them, thus eliminating much internal obstruction and allowing more operators access to the job.

The extensive use made on self-jigging subpanels has greatly reduced the fabrication in place in these fuselage unit assembly jigs.

"We have cut the production cycle from first pressings to rollout down to 12 months," Courtman said. This cycle for the freighter, which grosses 97,000 lb., is now even less than that for the Sea Hawk single-seat naval fighter which is now in the process of being phased out at Armstrong-Whitworth's Baginton production factory.

Other advantages claimed for the glass fiber jigging were its low price, light weight and ease of location.

A jig can be lifted by one man, so that instead of days it takes only hours to strip the "gates" after the main assembly joints have been fixed, thus giving full access to the interior of the fuselage. In spite of the open triangulation used in the jigs they were adequately stiff, Armstrong-Whitworth emphasized.

The fuselage unit assembly jigs for the military aircraft have now been fully developed for production and the temporary staging used for the civil production program has been abolished. The jigs now have permanent platforms at two levels, each supplied with services.

Major modification to the basic Argosy design in the military variant is the replacement of the full-width side-opening rear door with a beaver tail. Full-width nose freight door is optional.

The new tail was attached to a civil Argosy last autumn for aerodynamic testing, and flight tests have confirmed wind tunnel work. Only very minor changes have been made, and operation of the beaver tail in flight is almost trim-free and in both positions is free from buffeting.

Lower element of the beaver tail acts as an integral loading ramp without needing supports for loads up to 5,000 lb. Beyond that the fuselage is hydraulically jacked to stabilize it during loading.

The maximum payload of the AW 660 of 29,000 lb., and fuselage capacity of 3,680 cu. ft., can accommodate a large variety of military stores.

Maximum pallet width is eight feet. Most of the guided weapons in current use can be accommodated.

The fuselage is pressurized and air conditioned and can lift 69 fully-equipped troops or 48 stretcher cases to the aircraft's cruising altitude of 20,000 ft.

Usable fuselage length is 45 ft. disposed equally about the forward center-of-gravity position. Air-dropping is normally carried out using two platforms each with a maximum load capacity of 14,000 lb. The aircraft's roller conveyor system is used for gravity-dropping, a typical load being 11 one-ton containers. A landing load could consist of a 25-pounder gun with a one-ton trailer and one-ton truck.

The AW 660 has a flight refueling probe above the flight deck which is routed outside the fuselage into the wing leading edge.

An auxiliary gas turbine mounted in the port boom supplies power for starting and systems checks.

The AW 660 transport has a range with full payload of 500 naut. mi. or 1,200 naut. mi. with 20,000-lb. payload, both with 1½ hr. fuel reserve for holding. Average cruise speed is 233 kt.

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SPECIFIED: CONTROL SWITCHES

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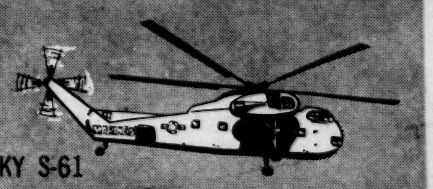
SIKORSKY S-61
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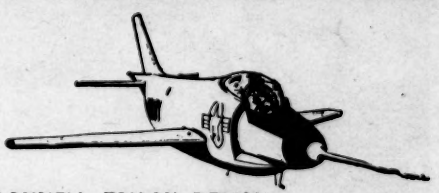
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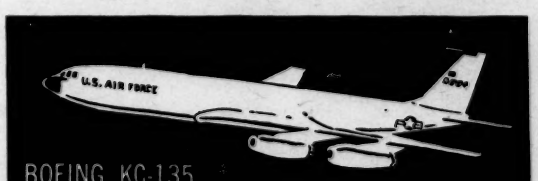
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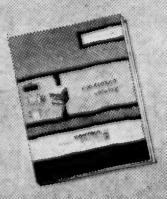
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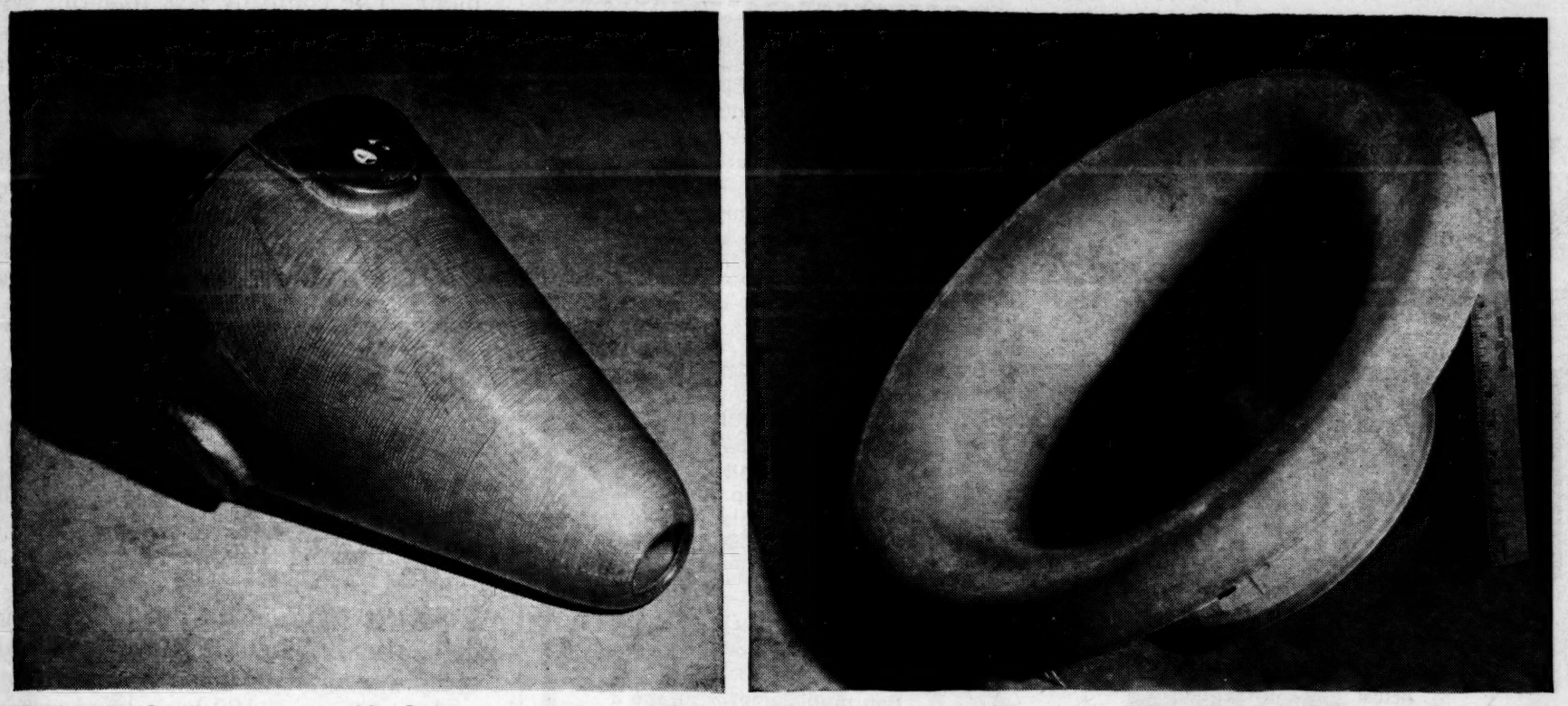

IMBEDDED heating wires provide de-icing protection on the propeller spinner ot the Grumman AO-1 Mohawk (left) and the circular intakes of the Sikorsky S-61 transport helicopter. The plastic laminate construction is said to be easily repairable.

Inlet De-icing System May Save Weight

New York—Fast-cyclic electric de-icing systems for turbine engine inlets may offer substantial weight and power savings without sacrificing positive protection against ice ingestion.

Proponents of the de-icing method assert that a 10-lb. system can provide inlet ice protection covering an area of 1,000 sq. in. with less than 1,000 watts power.

A fast-cyclic system, used on the engine inlets of the Republic F-105 fighter-bomber, combines continuously-heated parting strips at an average watt density of 13 watts psi. along stagnation areas.

The heating wires in the F-105 inlet de-icer are imbedded within a stainless steel sandwich construction. Cox & Co., New York, N. Y., producers of the F-105 inlet de-icing system, say that for most inlet applications a glass fiber laminate is satisfactory. This would afford considerable cost savings in comparison with the stainless steel construction.

In addition to the fast-cyclic electric de-icing system, Cox produces continuous-heating and slower cycling (called semi-cyclic) systems used on the engine inlet ducts of the Sikorsky HSS-2 helicopter and on the spinners of Hamilton-Standard propellers on the Grumman AO-1 Mohawk. Both of these applications employ glass fiber laminates with a protective erosion coating. Cox says that its fast-cyclic system in a plastic laminate will offer more positive ice protection than other electrical systems at less weight, lower cost and loss of thrust than engine bleed systems.

The company, bucking the trend toward hot-air inlet icing protection, says its fast cycling system is both lighter and less complicated. Industry resistance to electrical inlet anti-icing is due to the difficulty in adapting it to complex inlet shapes, thermally unsuitable structure and its complex heater designs.

The plastic laminate fast-cyclic anti-icing system proposed by Cox incorporates imbedded Thermowire heaters. The heater wires, spaced no greater than .017 in. apart, are imbedded beneath one layer of glass cloth and the erosion-protective coating. At low watt densities this design will have a 30% lower thermal efficiency than surface-film-type heaters, which lie just beneath the protective coating. Cox asserts that at higher watt densities used in its fast cycling system (20 to 40 watts psi.) this difference in thermal efficiency will be reduced.

Against the thermal disadvantage of the fast cyclic approach to inlet de-icing, Cox cites several advantages. Thermowire heater, when molded in the plastic laminate, is good for the life of the aircraft and, if damaged, is easily repairable. Despite the many internal circuits there are no cold spots due to the .042 maximum wire spacing and no internal or external cold leads are needed to connect internal circuits.

Another advantage cited for the imbedded wire heater is that precision arrangement of power densities and internal circuits is assured by molding the heater to the exact shape before it is used as one layer of the laminate. Additionally, as many parallel, series or series-parallel internal circuits may be incorporated as needed without external leads or internal busbars. Three-phase homogeneous or separated winding patterns may be used with no effect on the molding operation. External power leads can emerge anywhere and can be grouped in one area.

Although this construction is commonly used with both continuous-power and semi-cyclic systems, fast-cyclic anti-icing systems with the plastic laminate structure are not in use.

In the design of a fast-cyclic anti-icing system, the Cox company suggests as a basic design characteristic a one-minute cycle or cold time for free stream temperatures between 10 and 32F. Temperatures ranging between minus 22 and plus 10F would necessitate longer cycle times. The cycles would be automatically controlled by means of a two-speed cycler which would be actuated by a temperature sensitive sylphon.

On-times required would be two or three seconds during the higher temperature range and longer in proportion to the longer off periods at the cold temperature cycle. Cyclic power densities would be about 25 watts psi. Continuous-power parting strips would be employed at stagnation areas and high aspect ratio cyclic segments would be designed to ensure non-damaging ice flakes.

This represents the Cox design which is designed to weigh less than 10 lb. and protect an area of 1,000 sq. in. with a 1,000-watt power require-

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PROBLEMATICAL RECREATIONS 53

A man walks one mile south, one mile west, then one mile north, ending where he began. From how many points on the surface of the earth can such a journey be made? (There are more than 1).

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ment. The company says that this system would offer less danger of ice ingestion damage than any system other than complete evaporative systems. The company emphasizes that—as with other electric anti-icing systems—the pilot must anticipate icing and activate the system prior to ice formation. Automatic energization of the system is advised when the temperature falls below 40F in instrument flight conditions.

Soviet Union Claims 63 Aviation Records

Moscow—Soviet Union claims its aircraft set 63 world aviation records in 1960, bringing Russian records to a total of 187 by the end of the year.

Soviets continue to insist that their delta-wing E66 holds the absolute world speed record with the mark of 1,344 mph. it set over a 100 km. closed course in November. This claim, repeated recently by V. K. Kokkinaki, chairman of the USSR's Aviation Sports Federation, ignores the 1,390 mph. record set in September by the U. S. Navy-McDonnell F4H-1.

Russians claim their records were set by "sportsmen" pilots, but some of them were Red air force test pilots. One of three Soviet test pilots recently decorated was Vladimir Ilyushin, son of aircraft designer S. V. Ilyushin, who received his award for setting a 94,973-ft. altitude record in 1959 with a T-431 turbojet aircraft.

Poland claims a world record for gain in altitude, from field elevation to pressure altitude, for a single-place sailplane. The 33,762 ft. record was set by Stanislav Jozefczak in a Mukha-100A.

Rotating Combustion Engine Data Revealed

Detroit—First test stand data on two rotating combustion engines, revealed here at the 1961 Society of Automotive Engineers International Congress, reflected solid technical progress of the program under way at Curtiss-Wright Corp. (AW Apr. 18, p. 73).

Company has built and run a wide range of forms of the engine including one rated at 100 hp. and another at 782 hp., to establish parametric information on the concept and to get the development program on a firm foundation.

Smaller of the two engines was exhibited at the congress. It has 60 cu. in. displacement, is water-cooled and has an external flywheel. Test-stand data shows a minimum specific fuel consumption of 0.47 pounds per horsepower hour, increasing to 0.54 at maximum power rating of 100 bhp. at 5,500 rpm.

The larger engine is dimensionally a

Borescope Inspection

Miniature borescope permits inspection of rear braze joints of nozzle vanes set $\frac{1}{10}$ in. apart on a gas turbine inlet manifold assembly made by Aerojet-General for a liquid fueled rocket. The instrument, which was especially designed for this job by National Electric Instrument Division of Englehard Hanovia, Inc., has an outside diameter at its lower end of .081 in. Lower tube contains a prism and field lens both .068 in. diameter and two, two-element erector lenses also .068 in. diameter. The image picked up by the lower end optics is sent up a second tube of slightly larger diameter by a first surface mirror set 45 deg. in an elbow section. The second tube contains another two-element erector lens and an ocular lens to magnify the image. Light for the inspection operation is provided by inserting a miniature trouble lamp into the inlet opening on a flexible wire.

three-times blowup of the 60-cu. in. unit. Displacement of the big engine is 1,920 cu. in. The engine started and ran at the first attempt, and preliminary test data shows it to be capable of developing 782 bhp. at 1,525 rpm. Problems with detonation were encountered in this size and are currently being investigated.

Company spokesmen emphasized it was too early to talk about possible applications or markets for the engine. They said it currently is a proprietary item, with the entire program being supported by corporation funds. But possible applications at some future date could include helicopters, where the small size and weight of the engine could make it competitive with the gas turbine as a power source. Engine simplicity and low production cost could make it a cheaper powerplant per installed horsepower than current types.

Work to date has been solely with a water-cooled version. There is no technical reason why an air-cooled model could not be built, although it is too early to conjecture about that form, spokesmen said.

One problem is posed because the

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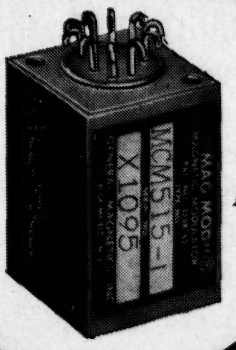

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Digital Programming
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engine runs hotter than other internal combustion types. Spark-plug life suffers as a result, and changes have been made in ignition and lubrication systems to compensate for increased cycle temperatures.

Curtiss-Wright is taking a conservative and cautious approach to development work with this engine. Spokesmen see another one or two years of development work ahead before the engine is ready for useful applications and they are reluctant to speculate about any future possibilities at this time.

Glass Fiber Blades Made for Compressors

London—Reinforced glass fiber blades are being developed for compressor rotor systems by Rolls-Royce and Bristol Siddeley, but application of the light weight components probably will be limited to military engines until the technique is proven.

Bristol already has developed production techniques, and rig testing is proceeding on low pressure compressors of a size comparable to the BS 53 Olympus 30,000-lb. thrust engine, which is destined for installation in the STOL TSR.2 strike-reconnaissance aircraft.

Parts of the BS 53 already made of reinforced plastic include the cold air deflector nozzles, some lightly loaded sections of the engine casing and the inlet guide vanes. Fan blades currently are metal.

One of the first Bristol Siddeley engines to use plastic blading in the first compressor stage was the Viper Mk. P. 187 prototype, which first ran over three years ago.

Rolls-Royce interest in plastic blading was indicated in a report by Chief Engineer H. Pearson, who says a great increase in thrust-to-weight ratio probably is possible with plastic components. The company has claimed a ratio of 16-1 for its small turbojet lift engines, due mainly to weight saving through use of plastic blades.

Aircraft Firms Expand Avionics Activities

Washington—General Dynamics, McDonnell Aircraft and Douglas Aircraft recently moved to expand their avionics activities as part of corporate diversification efforts. Douglas and McDonnell are the last of the major aircraft companies to move into the avionics field.

These moves were made to broaden avionic activities:

• **General Dynamics** has formed a new corporate division, General Dynamics/Electronics, under which it will consolidate all the activities of its former

Stromberg-Carlson Division plus the Electronics Division and Instruments group of Convair-San Diego.

• **McDonnell Aircraft Co.** has formed an Electronic Equipment Division to develop, design and produce avionic equipment, both for the company's weapon systems programs and for outside customers.

• **Douglas Aircraft Co.** is negotiating to acquire a "substantial interest" in Midwestern Instruments, Inc. of Tulsa, Okla. Company produces recording and data processing equipment.

The newly formed General Dynamics/Electronics, headed by James D. McLean as president, employs over 11,000. Combined sales of the new division are expected to total slightly under $200 million annually.

The new GD/E will consist of four operating divisions: Military Products, combining the defense electronics activity of the former Stromberg-Carlson Division in Rochester with the Electronics Division of Convair-San Diego; Information Technology, combining the instrument group of Convair-San Diego with the Charactron display and data handling group in San Diego which was spun off from Convair several years ago; Telecommunications, including the radio and telephone communications activities in Rochester, and Commercial Products.

McDonnell's new Electronics Equipment Division, headed by Fred A. Darwin, is an amalgamation of many separate electronics groups which have grown in the company. New division's current employment is around 2,000, and last year's sales were about $25 million. Principal products have included trainers and simulators, such as the procedural trainer for Project Mercury pilots, automatic checkout equipment and flight control systems.

Midwestern Instruments, Inc., with which Douglas is negotiating, has itself grown via the acquisition route. The company merged with Magnecord, Inc., maker of tape recording equipment, in 1956 and acquired Data Storage Devices Co. the following year. Midwestern's products include servo valves, ground telemetry equipment, oscillographs and tape recorders.

Eclipse to Be Viewed Aboard Soviet Tu-104

Moscow — Soviet Tu-104 turbojet transport will be used to give Russian astronomers an extra 75 sec. in which to view a total solar eclipse expected on Feb. 15.

Scientists aboard the jet will investigate the solar crown in infrared and visible fields of the spectrum, attempt to obtain crown photographs, and also will study the chromosphere.

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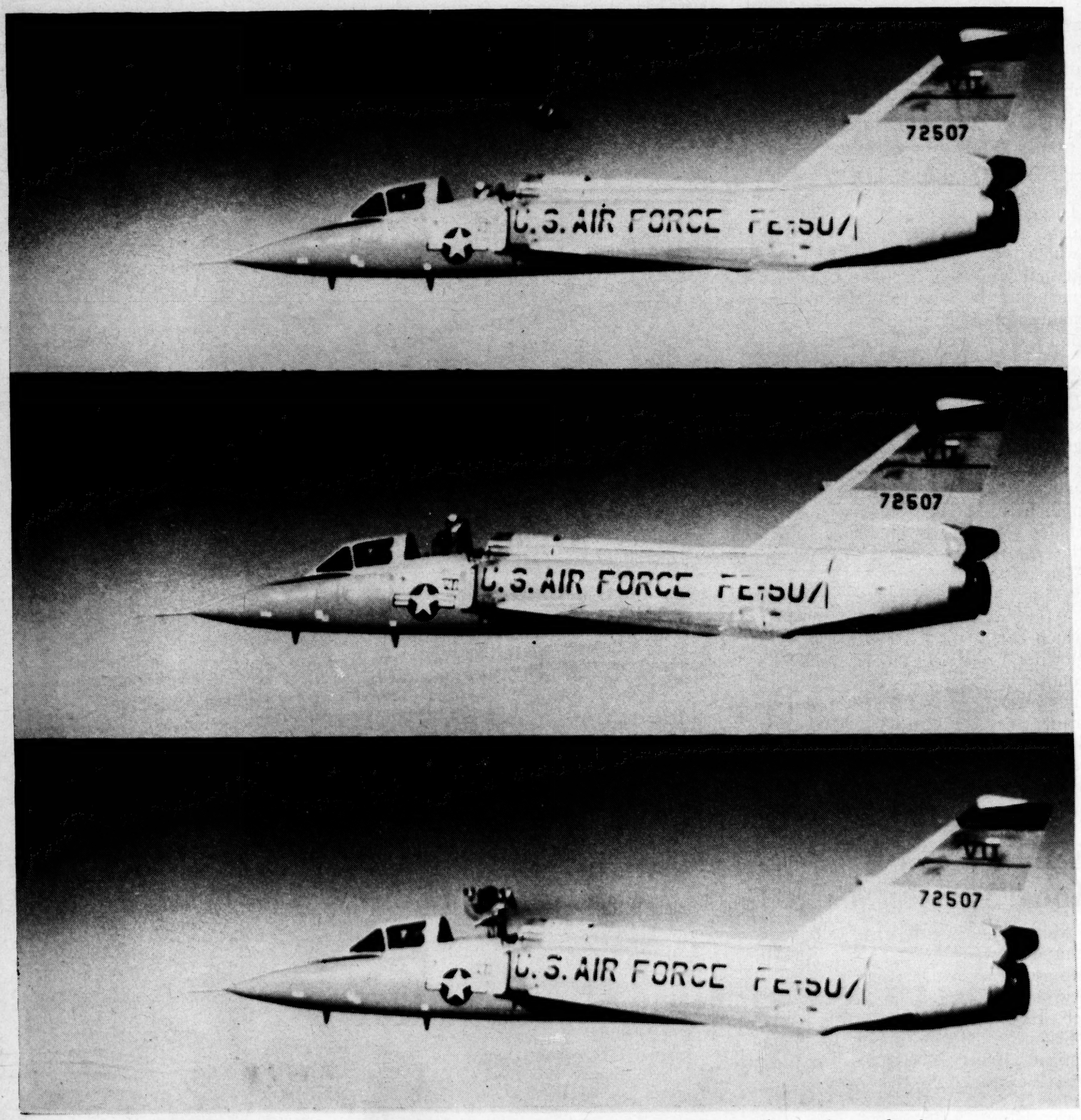
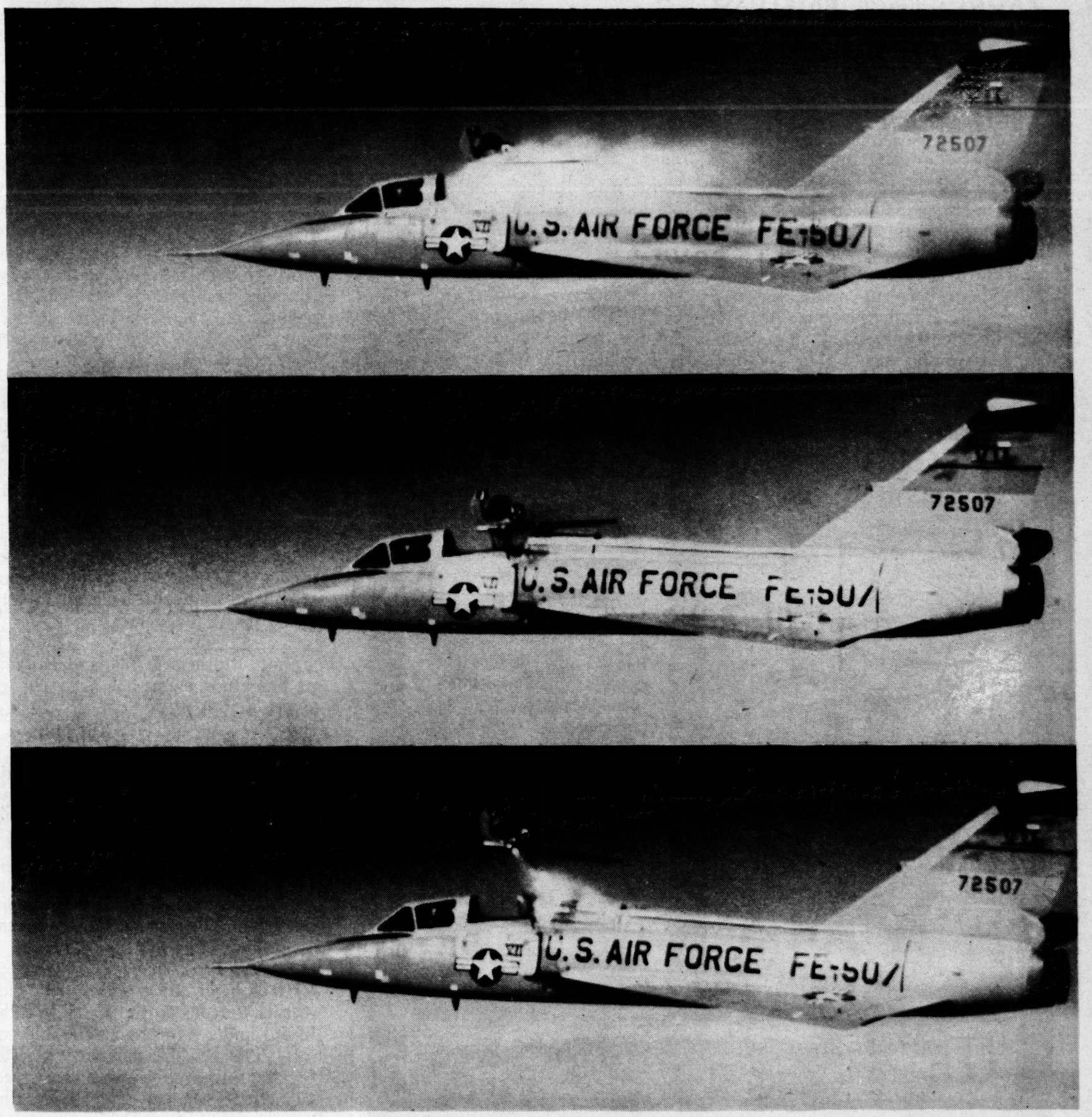
Supersonic ejection seat flight test conducted recently over Holloman AFB, N. M., is recorded in photo sequence showing dummy fired from Convair F-106B. Initial test of Convair-designed rocket-propelled ejection seat was conducted at relatively low speed.

Air Force Tests Convair Supersonic Ejection Seat



Rear canopy of the F-106 flies off when pilot triggers the ejection system. Seat emerges from cockpit and immediately rotates one-quarter turn backward. Stabilizing arms extend from the top of the seat so that deceleration is borne by pilot through his long axis.



Rocket motors, fired in sequence, propel the seat and pilot up and forward in order to clear the vertical stabilizer. Pilot remains with the seat in a free fall through rarified upper air until he reaches 15,000 ft. altitude. Barometer-controlled device then automatically releases pilot's seat harness and he is pulled free by a drogue parachute. Immediately afterward his own parachute opens automatically. The supersonic ejection seat project is under the cognizance of Wright Aeronautical Development Division of ARDC.

PRODUCTION BRIEFING

Rocket Power Division of the Gabriel Co., Mesa, Ariz., has been awarded a $100,000 contract for PIMA rocket boosters by the U. S. Army Proving Grounds, Ft. Huachuca, Ariz.

Britain's Ministry of Aviation will place its three Saunders-Roe Princess flying boats on the auction block. The 157-ton flying boats, which were canceled due to the lack of a suitable powerplant, have been in mothballs since 1954. The British government states that the sale of the aircraft may stimulate a re-examination of their commercial potential. There are 44 tons of aluminum alloy in each hull.

Vickers, Inc., Division of Sperry Rand Corp., has been awarded a $127,000 contract by NASA to determine the feasibility of a rocket attitude control system. Vickers system will have a solid-propellant gas generator that exhausts gases through a network of proportional valves to produce attitude and roll correction forces.

Del Mar Engineering Laboratories has received a contract for $1,012,559.50 from the Bureau of Naval Weapons for the production of lightweight-pressed fiber and foam targets that can be towed at lengths to 6½ mi. behind a fighter aircraft. The expendable targets which will be used in air-to-air missile training are designed to be launched and recovered in flight. Deliveries of the targets will run from April through August, 1961.

Westinghouse Electric Corp. will manufacture electrical systems for the first 40 Boeing 727 transports under terms of a $1,000,000 contract from Boeing Airplane Co. The equipment will include a starter generator that will function first as a starter for the jet engines and then as an alternating-current brushless generator supplying power for the aircrafts' operation.

Huyck Systems Co. of Huntington Station, New York, has been awarded a $675,000 contract by Lockheed Aircraft Corp.'s California Division for an airborne latitude-longitude indicator-computer. The indicator-computer accepts inputs of North-South and East-West distance traveled and converts this data to present position readouts. It will be used by Lockheed in retrofitting its ASW aircraft.

Short Brothers & Harland Britannic air freighter's name has been changed to the Belfast (AW Sept. 28, 1959, p. 43.)

Tool Research and Engineering Corp., Beverly Hills, Calif., has received an initial contract of approximately $2,500,000 for tooling on the B-70 Valkyrie bomber program. The North American Aviation, Inc., contract is for jig and fixture and special tooling for the building of sections and subassemblies of the B-70.

HRB-Singer, Inc., will supply radar weather beacons to the U. S. Weather Bureau under terms of a $108,000 contract. The new beacons are transistorized and improved versions of a beacon originally developed by the Weather Bureau's Washington laboratory to collect rainfall data.

Radiation, Inc., Melbourne, Fla., has received two contracts from NASA; one, for an undisclosed amount, for pulse-code-modulation (PCM) telemetry system for Nimbus and the second, for $100,000 for reflectivity measurements of Echo and other passive satellites.

Control Corp. of Minneapolis, Minn. has received an order amounting to $148,000 to furnish control and remote metering equipment for the U. S. Navy jet fuel storage system in Hawaii. The order is a subcontract from Patterson, Emerson and Comstock, who are the prime electrical contractors.

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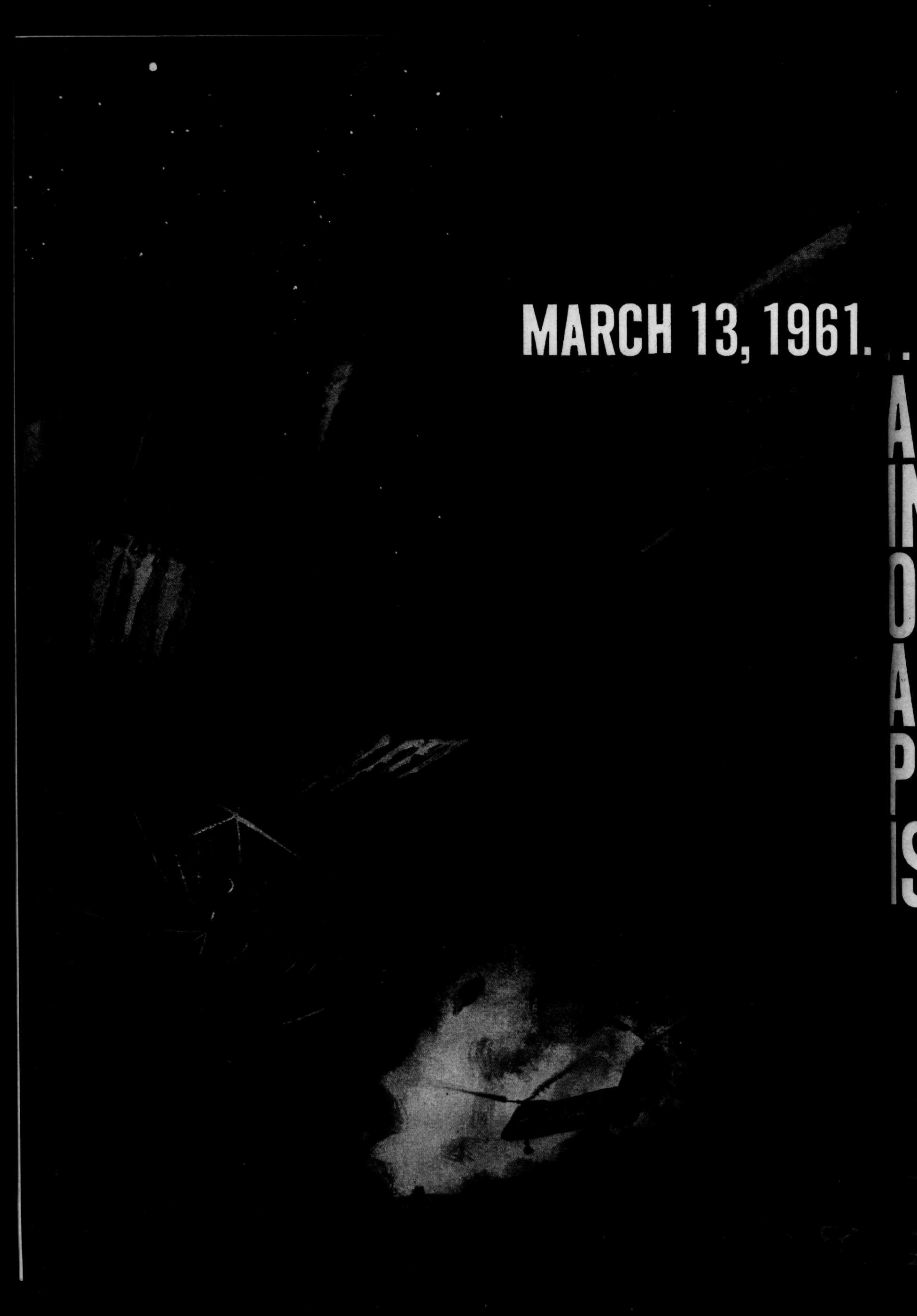
Bell T63-Powered HUL-1M Makes First Flight

Bell Helicopter Co. has successfully completed a hover test with its Allison T63 turbine powered HUL-1M (AW Jan. 2, p. 19) at Fort Worth, Tex. Hover check flight was authorized by U. S. Navy before completion of the 20-hr. initial flight test tie-down run to gather engineering data on control responses and general operation. Pilot Lou Hartwig used cyclic control to test pylon support, termed softest mounting yet used in the Bell 47 series. The 20-hr. run was completed Jan. 20 and aircraft now is being readied for the contractor's 10-hr. flight test phase prior to Navy evaluation flights. Work is being performed under a Navy contract received in 1959 calling for two Bell 47J models to be converted to the Allison turbine engine. Tests mark another Bell turbine project; in 1954 a Turbomeca Artouste engine was installed in a standard H-13 for evaluation and Bell has had experience with Lycoming T53 turbines mounted in its HU-1 Iroquois series. HUL-1M useful load will be 1,500 lb.

MARCH 13, 1961.



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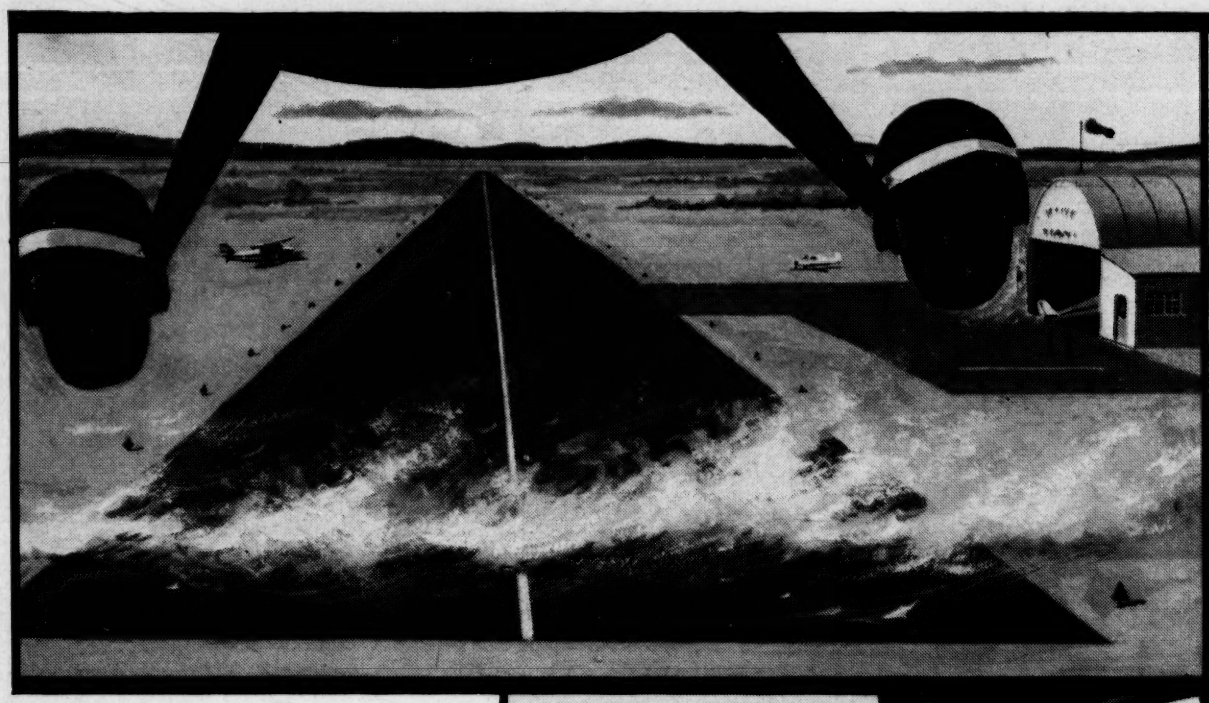
PUBLISHING DATE: MARCH 13, 1961

Esso WING TIPS

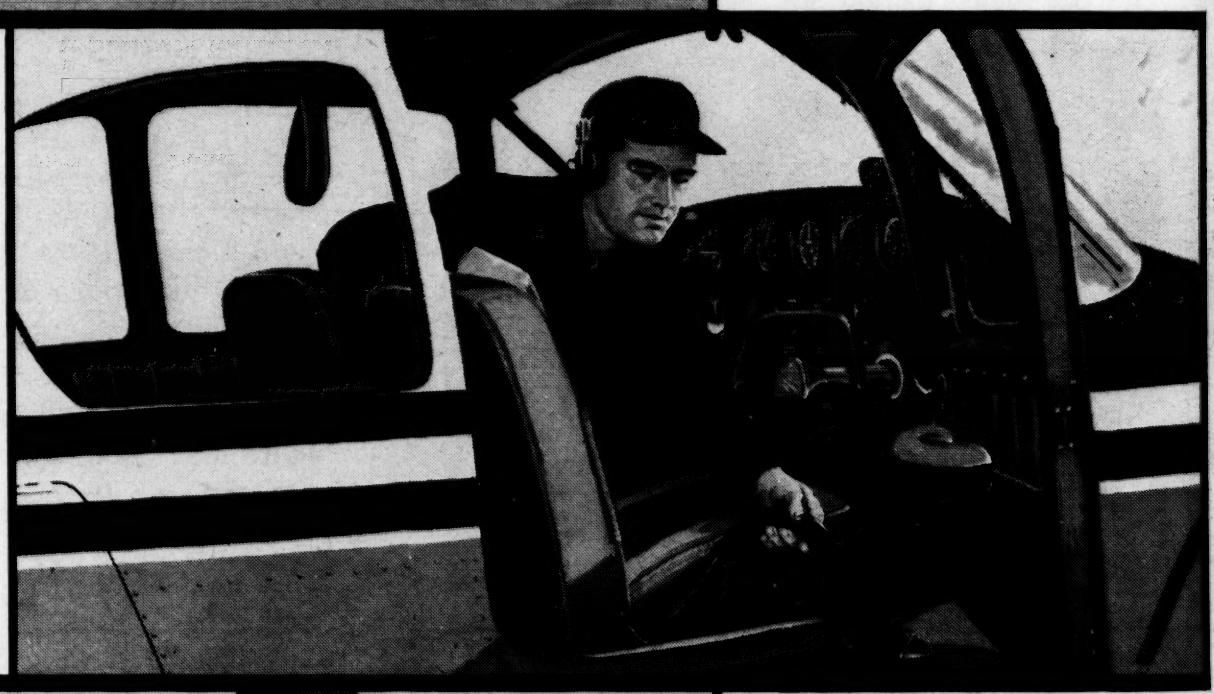


WATCH FOR "GUST DUST"!

While making your approach, keep a keen eye out for low level, wind-blown dust near the runway. If it's moving in a different direction than the wind sock, you should expect turbulence or cross winds as you're touching down.

TUCK IN BEFORE TAKE-OFF!

Sounds fantastic, but many a carefree pilot has taken off with a seat belt dangling out the door of his plane. In flight, a dangling seat belt can create terrific noise – even damage – as it raps against your fuselage. So keep seat belts inside . . . and fasten 'em!



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He provides you with aviation fuels and lubricants of the same high quality that has made Esso a respected name with America's leading airlines. What's more, he takes an interest in seeing that your plane gets maximum performance aloft. Next time you're touching down, make your approach at the Esso sign!

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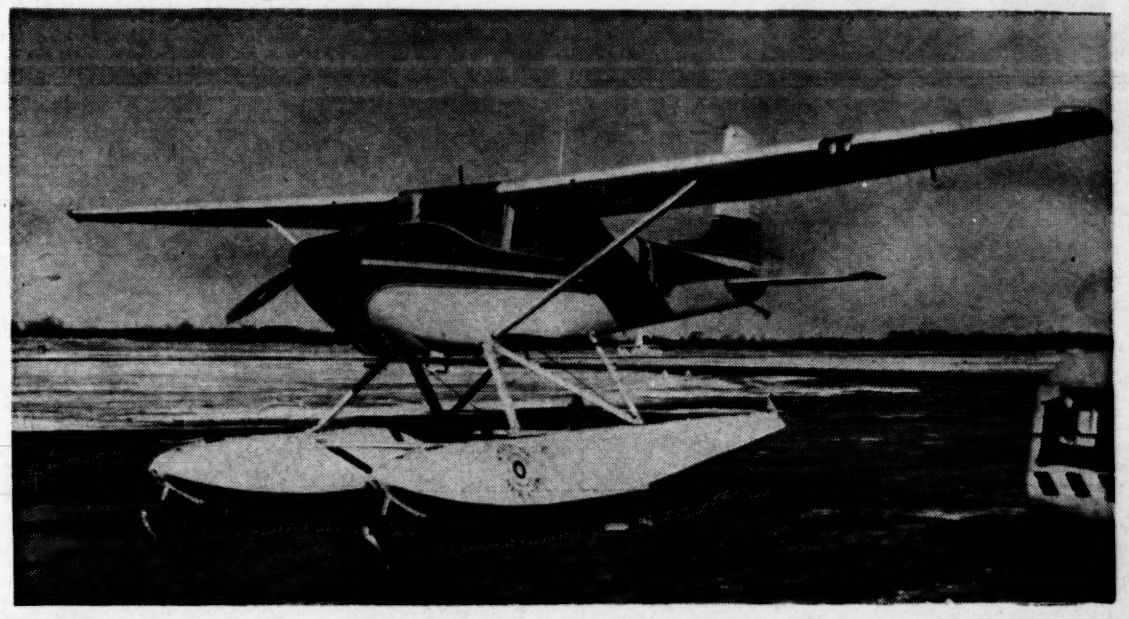
New York Surveys Fish Toll From Air

By Arnold Sherman



CESSNA 180, equipped with floats, is being used by the New York State Department of Conservation to evaluate the extent of fishing pressure exerted against particular species of fish in the Long Island area. Project requires close coordination between pilot and marine biologists. Expanded coverage of the entire area is planned as a result of the surveillances.

Albany, N. Y.—New York State Department of Conservation is planning to increase its aerial coverage of the Long Island area. Until recently aerial reconnaissance of Long Island fishing grounds has been restricted to the Great South Bay area but aerial coverage is planned for the entire south shore including the Block Island, Peconic Bay areas.

Flying a Cessna 180 equipped with floats, pilot-conservationist John Schempp has been flying low-level surveys of fluke in the Great South Bay area.

The Long Island reconnaissance falls under Conservation Department "Project Fishing Pressure." The project calls for close coordination between Schempp's flights and marine biologists stationed at Freeport, L. I. Quantities of fish (in this case fluke) are netted, tagged for future identification and then released.

In order to determine the approximate toll taken of these fish by anglers, frequent, low-level flights are made. Charter fishing craft, dinghies, private cruisers are identified along with the number of fishing occupants on each. These figures are later correlated with the number of fish known to be in the area and the Department of Conservation then has a fairly accurate idea of how the fish are faring.

The fluke having been successfully tabbed and their rate of survival noted, Conservation is planning to move on next to flounders.

Project Fishing Pressure illustrates the increasing utilization of aircraft by the Conservation Department in New York. Aircraft are used not only for broad, fast coverage as in Great South Bay activity but also, and with more frequency, for determining the quantity of wild life in remote forested areas, for noting the migrational habits and idiosyncrasies of various species and for ascertaining what effects man is having on their normal development. "We've reached a point," Schempp noted, "where we realize that much of the work we've undertaken couldn't possibly be accomplished in any way but by air."

Schempp, 42, is a Cornell University graduate in wild life conservation. He was a pilot in World War II and joined the Department of Conservation immediately afterward.

"We started out with a surplus Stinson L-5 and had it equipped with wheels, skis and floats. Later we graduated to the Stinson Station Wagon and finally picked up the Cessna 180 which we've been using for the past three years," he explained.

The Cessna is used exclusively for aerial observation. A Grumman Goose and later de Havilland Otters were put to the task of stocking lakes and streams. The Otter, equipped with a dump hatch, flies low over lakes in remote parts of the state, dropping its cargo of fish like so many bombs.

Aerial photography is one of Schempp's frequent duties. The 180 is equipped with a Fairchild Model K-20 aerial camera used for taking oblique shots of the terrain. These pictures are collated and field maps are drawn from them. Later, when a need exists for locating suitable animal breeding grounds, the map shows precise locations.

Terrestrial surface changes also are noted and carefully recorded for future references.

A Conservation observer flies with the pilot for on-the-spot census taking and fauna analysis. In census flights, the observer actually counts the animals or birds in question, the pilot meanwhile contributing by flying 20 to 30 ft. from the ground and thereby flushing the quarry. Realistic figures are then extrapolated on the basis of the seen versus the margin of unseen game. This method has proved surprisingly successful with beavers and muskrats, less so with deer.

Animals are not the only creatures counted. Hunters and fishermen are just as likely to be included in any Conservation census.

"Part of the job," Schempp noted, "is to locate where heavy fishing and hunting is taking place so we can pinpoint the areas for future examination. That way we know where and when to look."

Illegal Fishing Nets

The 180 has been used with some success in ferreting out illegal fishing nets which are visible from the air and in curtailing the unauthorized "jacking" of deer.

Conservation planes are hangared in Albany. Pilots work in close coordination with the wild life research laboratory in Delmar, N. Y.

The U.S. Federal Fish and Wild Life Service is an active partner in New York State's aerial conservation program.

The federal government pays three quarters of the aircraft operating expenses including pilots' salaries and maintenance of the planes.

NAA Is Planning Increased Activities

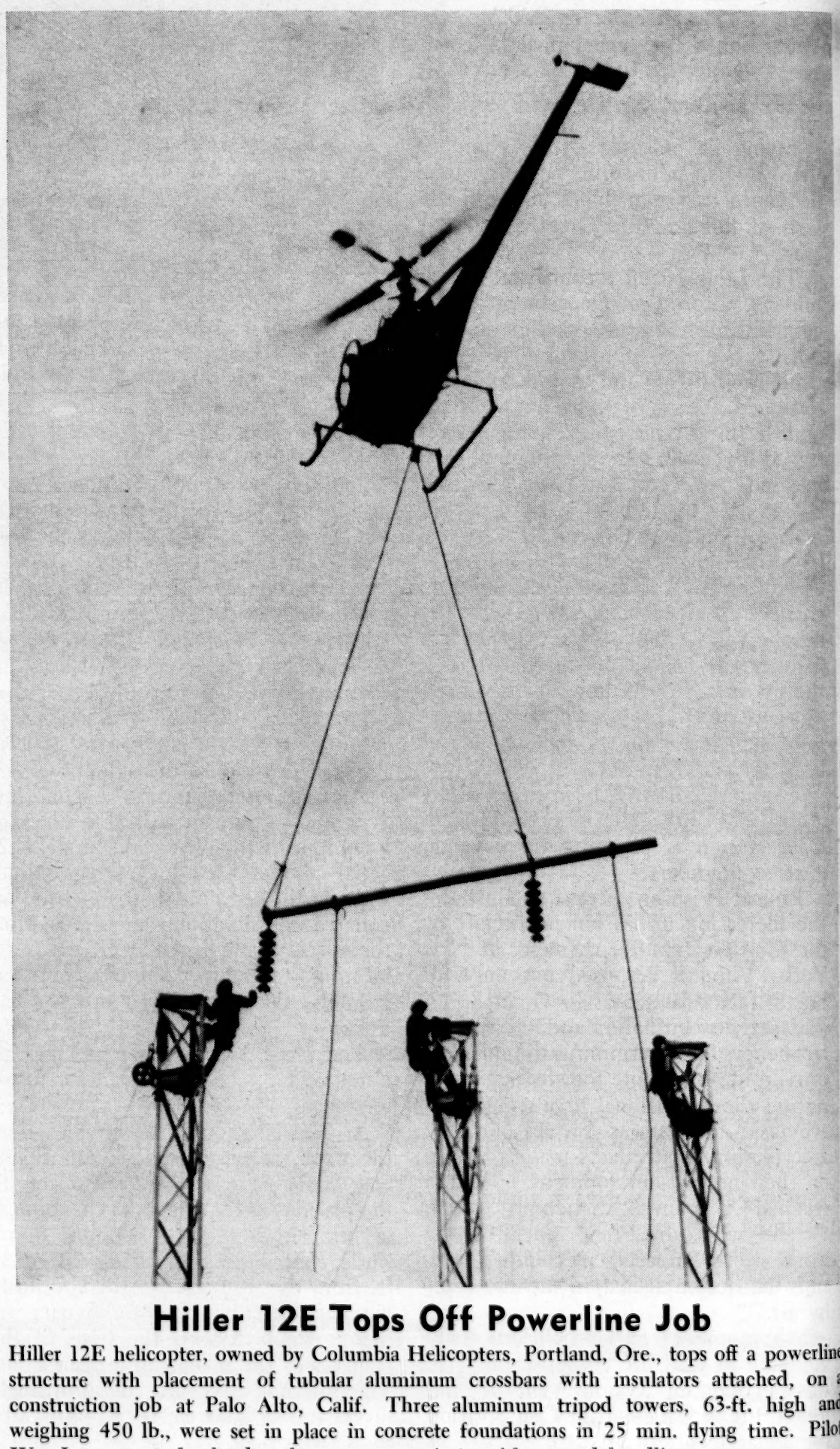
Dallas, Tex.—National Aeronautic Assn. plans to expand its scope of activities and build the organization financially to better serve private flying and industry.

A major area in which the organization plans to work is to attempt to develop a working relationship with the scores of current aviation organizations

now in existence to provide them with a cohesive, centralized "voice" in presenting problems basic to the interests of them all to the government agencies which have responsibilities for solving the problems.

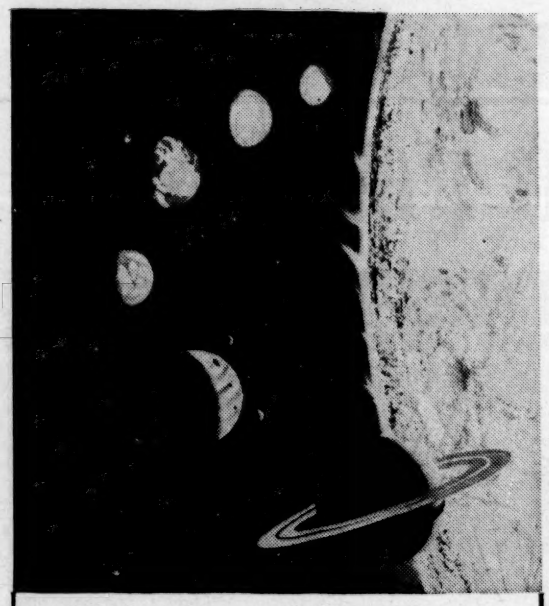
NAA representatives met recently with members of approximately a dozen of the leading private aviation organizations in Washington to discuss methods whereby such cooperation between them and NAA can be established. NAA feels that, with its established reputation for being an objective aviation group of international standing, it could provide a more effective sounding board for certain objectives confronting industry than can an organization which is labeled as representing the interests of one particular segment.

NAA would form a screening committee of perhaps seven to nine members to study problems proposed by other aviation organizations, or from industry, to ensure that only those which are common throughout aviation, and would not favor a particular segment, would be sponsored by the organization



Hiller 12E Tops Off Powerline Job

Hiller 12E helicopter, owned by Columbia Helicopters, Portland, Ore., tops off a powerline structure with placement of tubular aluminum crossbars with insulators attached, on a construction job at Palo Alto, Calif. Three aluminum tripod towers, 63-ft. high and weighing 450 lb., were set in place in concrete foundations in 25 min. flying time. Pilot Wes Lamatta used a loudspeaker to communicate with ground handling crews.



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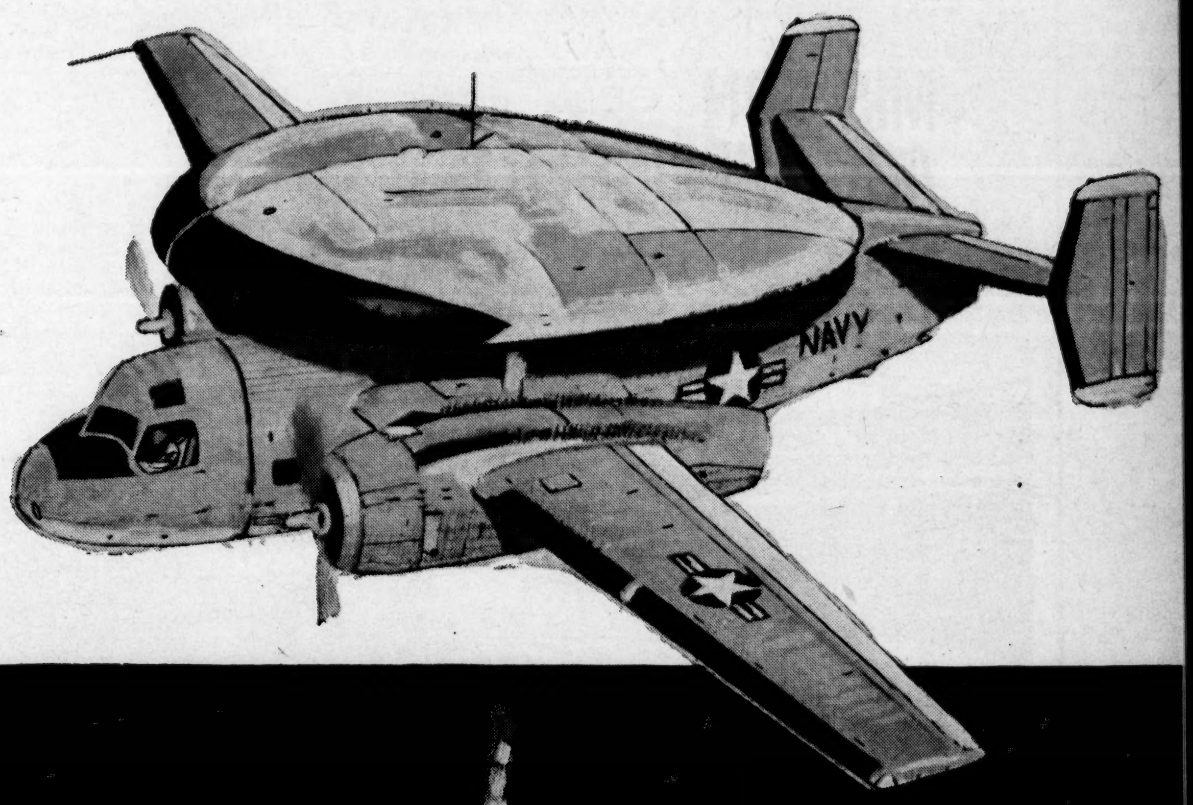

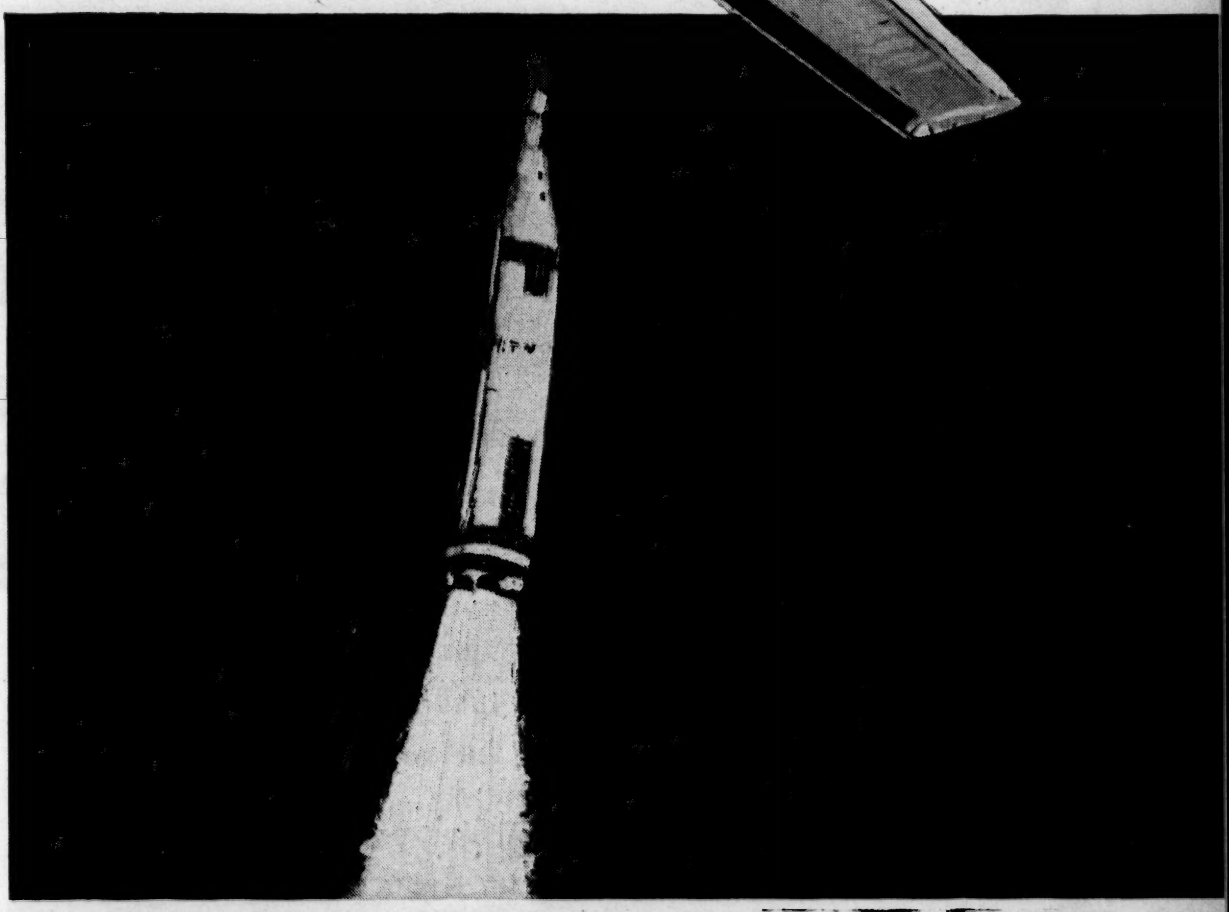

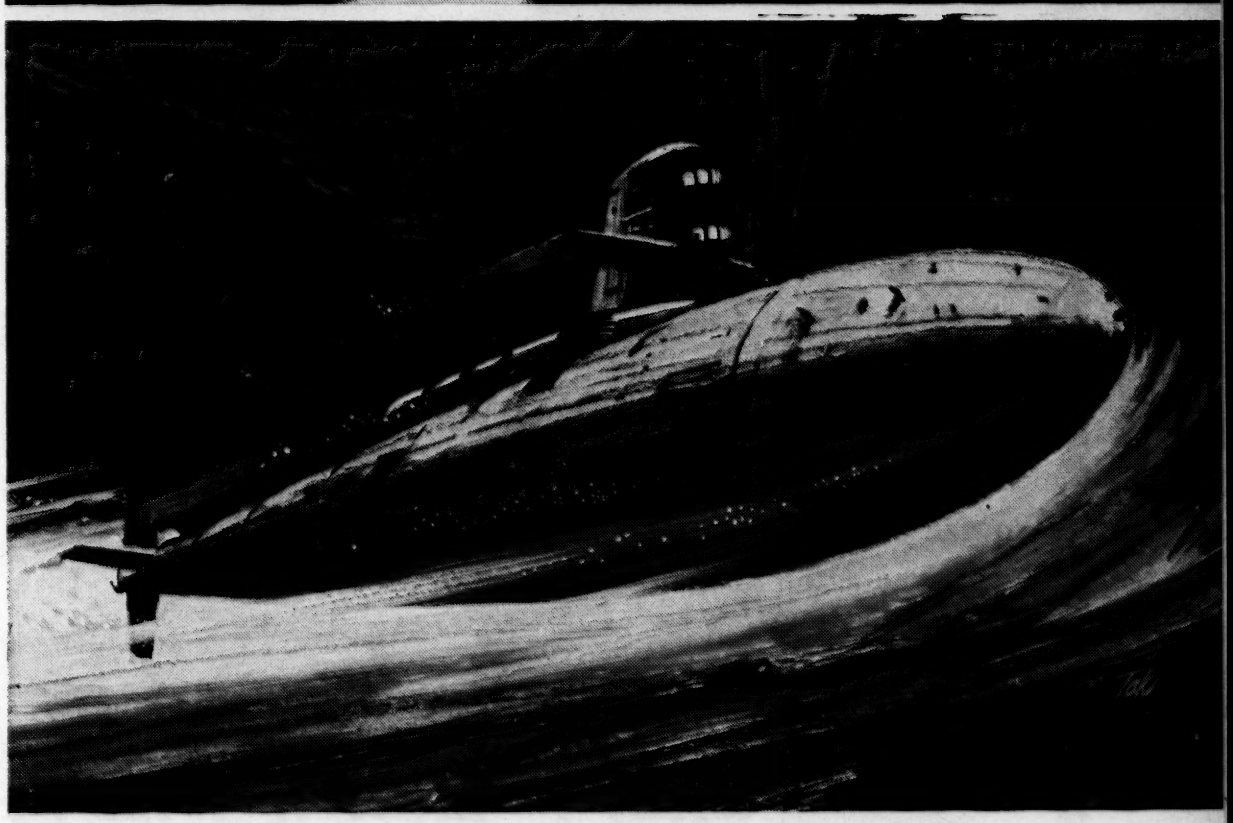

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For more than 15 years, Zenith has pioneered new techniques and production processes in plastics. Today, Zenith has the most completely equipped reinforced-plastics laboratories and the most complete electronic test facilities for reinforced-plastics components in the world.

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before congressional or other government agencies.

The organization hopes to build its treasury to provide means for expanding its activities by a new system of memberships in which manufacturers and other companies with aviation interests can join the organization, paying dues in accordance with the scope of their business—for example, a small company can subscribe for "one unit" ($250 annually) of corporate membership, while a larger firm can subscribe for several units.

NAA also will solicit paid advertising in National Aeronautic's Magazine for the first time in its 38-year history.

The organization also will sponsor a vigorous membership campaign, a feature of which will attempt to affiliate as many flying clubs now active in the U. S. as possible in NAA, and will promote development of new flying clubs and their activities.

President Jacqueline Cochran says that she will appeal to Congress to have the United States formally invite future international flying meetings to hold these events in this country—pointing out that the U. S. has never hosted any of these gatherings.

An attempt will be made to bring the international soaring meet to the United States this year, she stated.

U.S. Business & Utility Aircraft Shipments

November, 1960

Make & Model	No. of Units	Net Billings
Beech Model 18	4	
Model 33 Debonair	23	
Model 35 Bonanza	40	
Model 50 Twin-Bonanza	5	$4,037,000
Model 55 Baron	11	
Model 65 Queen Air	9	
Model 95 Travel Air	5	
Cessna Model 150	24	
Model 172, Skyhawk	91	
Model 175, Skylark	97	
Model 180	23	$4,060,000
Model 182, Skylane	17	
Model 210	12	
Model 310	21	
Commander Model 500A, E	9	
Model 560E	0	$1,522,000
Model 680E, F	9	
Model 720	1	
Mooney Mark 20	12	$234,000
Piper PA-18;Super Cub	20	
PA-22 Tri-Pacer, Caribbean	21	
PA-23 Apache	20	
PA-23 Aztec	13	$2,613,000
PA-24 Comanche 180	10	
PA-24 Comanche 250	48	
PA-25 Pawnee	33	
Totals	578	$12,466,000

Note: Total shipments for 11 months Jan.-Nov. 1960 were 6,792 aircraft having a total factory net billing value of $136,118,000. This indicates some drop in number of units over same period in 1959 when a total of 6,955 aircraft were delivered, although the 1960 11 month dollar volume shows an increase over the previous year's $118,587,000.

Miss Cochran also said that NAA favors establishment of a "Nobel-type award" of an international type, for services rendered aviation. Funds for such an award could be developed by NAA setting aside a minimum of 5% of its funds, plus adding contributions for such a prize for approximately five years, to build the fund to a respectable size for worthwhile grants.

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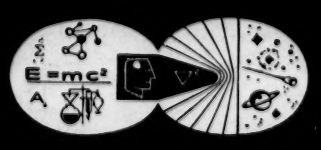
A thermally Regenerative Fuel Cell to light small cities, power magneto-hydrodynamic devices, submarines and space platforms . . .

These are some of the nuclear projects in progress at Allison, with several under government contract.

In their research and development efforts, our atomic scientists and engineers employ such facilities as a vacuum chamber which simulates pressures at altitudes in excess of 200 miles; physical chemistry, solid-state physics, metallurgical and materials laboratories; a liquid metal loop; analog and digital computers and many other research tools. Their efforts are aided by American and European consultants, our Scientific Advisory Committee, plus every resource General Motors possesses.

Whether your problem is concerned with the heavens, the earth or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others, we could do it for you.

Shown is heat exchanger section of a nuclear- or solar-powered Stirling-cycle engine under development for space and terrestrial power systems.



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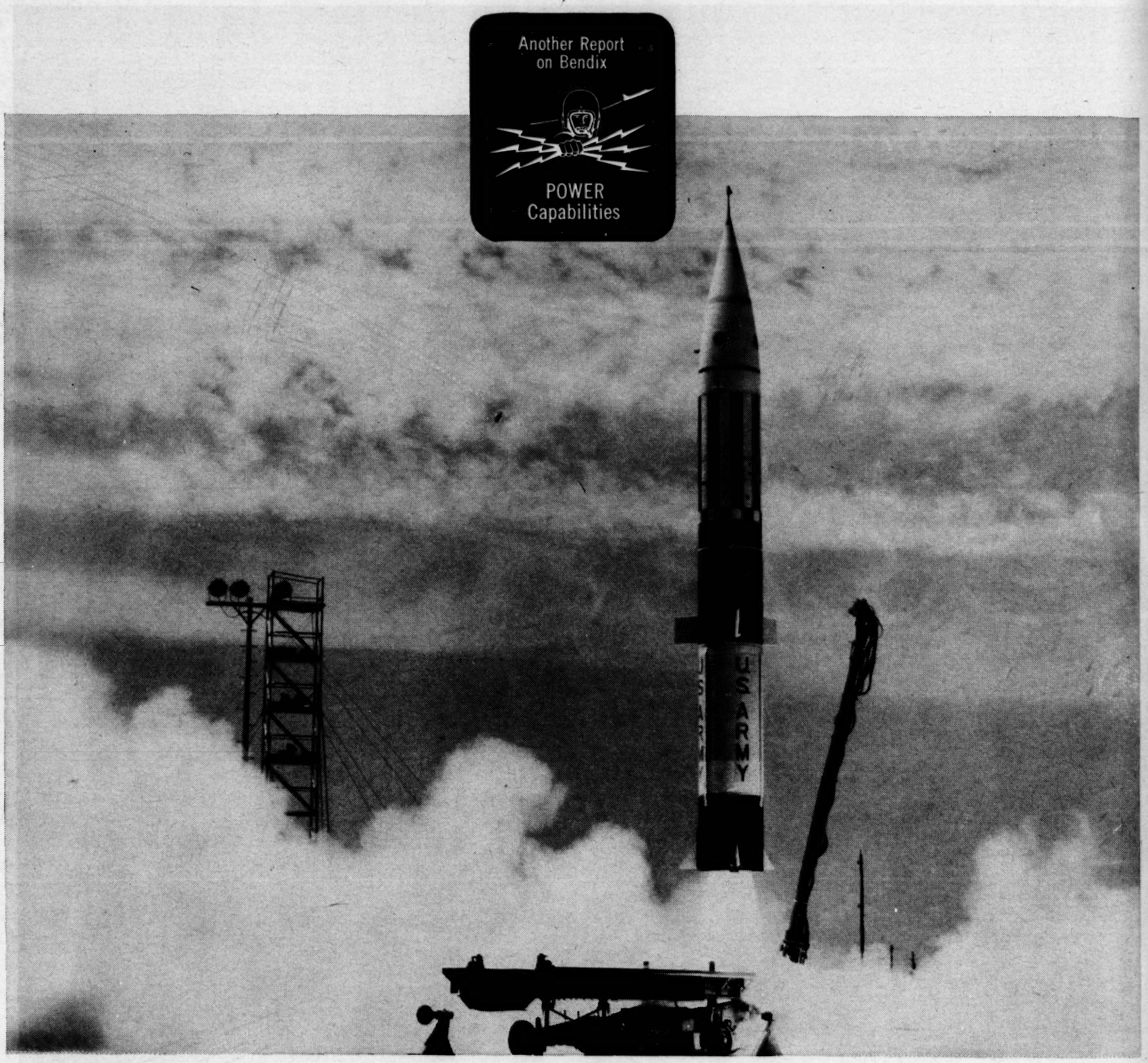

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command Aeronautical Systems Center:

Hughes Aircraft Co., Culver City, Calif., type I, GAR-3A Falcon missiles, cases, shipping and storage containers, handbook revision, spare parts and related data, contract AF 33(600)42070, $19,096,552.

Hughes Aircraft Co., Culver City, Calif., GAR-4A Falcon Missiles, cases, shipping and storage containers, handbook revision data, spare parts and related data, contract AF 33(600)42071, $18,336,304.

Hughes Aircraft Co., Culver City, Calif., GAR-11 Falcon missiles, Type I, shipping and storage containers, handbook revision data, spare parts and related data, contract AF 33(600)42072, $27,125,589.

Instrument Division, Lear, Inc., Grand Rapids, Mich., gyroscopic assemblies, displacement, Aerno 60-6316, 180 ea.; various quantities of components thereto, spare parts, ground support equipment and data (component of control assembly, attitude, gyroscopic, type AF/A24G-1), (installations for F-105D aircraft) letter contract AF 33(600)42199, $1,250,000.

Ampex Data Products Co. of Ampex Corp., Redwood City, Calif., demultiplexer assemblies, Ampex catalogue number 67940-10, five ea.; recorder/reproducer set, signal data AN/GLH-3(XH-1), one ea., and data, contract AF 33(600)42295, $269,039.

Federal Systems Division, International Business Machines Corp., Owego, N. Y., services for repair and/or modification of AN/ASB-9 and 9A bombing navigation systems, letter contract AF 33(600)42211, $212,132.

Aircraft Instrument Division, R. C. Allen Business Machines, Inc., Grand Rapids, Mich., indicators, turn and slip, four minute turn, type MD-8, contractor's P/N A1600, FSN 6053-6610-585-1145, Aerno 60-5074, spare parts, ground support equipment and related data, contract AF 33(600)42293, 273 ea., $31,682.

Instrument Division, Thomas A. Edison Industries of McGraw-Edison Co., Inc., West Orange, N. J., indicator, pressure, oil, type MO-2, contractor's P/N 217A-100A, Aerno 61-2476, FSN 6620-714-4201 (USAF installations), 573 ea.; transmitters, pressure, type TRU-20A, Aerno 61-2497, FSN 6620-690-8653 (USAF installations), 900 ea.; spare parts, tools, test equipment and data, RFP ES-1-6620-3144 and ES-1-6620-3174, contract AF 33(600)42228, $171,214.

The Aero Equipment Corp., Bryan, Ohio, regulator, oxygen diluter, (type CRU-21/A, applicable to F-105D aircraft), Aerno 46-3000, IFB 33-600-61-48, contract AF 33(600)42321, 741 ea., $149,682.

Pioneer Central Division, The Bendix Corp., Davenport, Iowa, indicator set, liquid oxygen quantity, type A/A24J-8, Aerno 46-1005 (applicable to T-38A series aircraft) maintenance and engineering data, IFB 33-600-61-57, contract AF 33(600)42361, 144 ea., $113,072.

Douglas Aircraft Co., Inc., Santa Monica, Calif., facilities for support of ground-to-air missile 87A program, supplemental agreement No. 2 to contract AF 33(600)40868, $25,000.

Bendix Support Equipment Division, The Bendix Corp., Teterboro, N. J., type AN/GJQ-9 checkout sequence programing sets (for the ground-to-air-missile 87 subsystem), exercise of option, supplemental agreement No. 5 to contract AF 33(600)41492, five ea., $374,133.

Pioneer-Central Division, The Bendix Corp., Davenport, Iowa., indicator indicated airspeed, AVU-2/A, Aerno 60-6303, spare parts, ground support equipment and data, IFB 33-600-61-33, contract AF 33(600)42271, 220 ea., $61,586.

John Oster Manufacturing Co., Racine, Wisc., indicators, rate of flow, type EFU-12/A, Aerno 61-2504, spare parts, ground support equipment and data, IFB 33-600-61-66, contract AF 33(600)42354, 584 ea., $290,832.

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UAC WEATHER SYSTEM CENTER
UNITED AIRCRAFT CORPORATION/EAST HARTFORD, CONN.

WHO'S WHERE

(Continued from page 23)

Changes

James H. Green, Jr., director, Space Communications Division, Alpha Corp., Dallas, Tex., a subsidiary of Collins Radio Co.

Dr. Curtis E. Miller, director of medical sciences, Dynamic Science Corp., South Pasadena, Calif., a subsidiary of Marshall Industries.

Thomas H. Tatham, product engineering chief, Ryan Transdata, Inc., San Diego, Calif., a subsidiary of Ryan Aeronautical Co. Also: **Omer F. Hamann,** chief of applied research; **Robert M. Peterson,** chief of design requirements.

James L. Clark, manager, Ballistic Missile Early Warning System program, Systems Engineering and Management Operation, Sylvania Electric Products, Inc., Needham, Mass.

Dr. G. V. R. Rao has joined the senior staff of National Engineering Science Co., Pasadena, Calif.

Dr. Selby M. Skinner, manager-molecular electronics projects, Westinghouse Electric Corp.'s Air Arm Division, Baltimore, Md.

Dr. Henry M. Clanton, manager, Special Systems Department, the Marquardt Corp.'s Pomona (Calif.) Division, and **Arvid G. Wedin,** head of the Simulator and Trainer Systems Department.

C. E. Fitton, Jr., head of Thiokol Chemical Corp.'s Advanced Concept Analysis Group, Rocket Operations Center, Ogden, Utah.

Frank Enge, head of Loral Electronics Corp.'s newly established activity for advanced communications, telemetry and space navigation systems, with headquarters in New York, N. Y.

J. W. C. Judge, pilot and aerodrome supervisor, F. G. Miles, Ltd., Shoreham Airport, Sussex, England.

Alexander B. Magnus, Jr., chief analytical engineer, Actuation Research Corp., Glendale, Calif.

Herbert I. Chambers, director of engineering, Data Recorders Division, Consolidated Electrodynamics Corp., Pasadena, Calif.

Donald Spooner, project engineer-telemetry and data acquisition systems, Electronic Development Corp., Boston, Mass.

Eugene A. Jackson, chief scientist for advanced research, Astrosystems, Inc., Livingston, N. J.

Fred A. Darwin, general manager of the newly established Electronics Equipment Division, McDonnell Aircraft Corp., St. Louis, Mo.

Alfred J. Wheeler, device development engineer, Micro State Electronics Corp., Murray Hill, N. J.

S. Edward Franklin, chief engineer, Klixon precision controls, Metals & Controls, Inc., Attleboro, Mass., a division of Texas Instruments, Inc.

Joseph L. Comer, marketing manager, Electronics Division, The Martin Co., Baltimore, Md.

Lovell Lawrence, Jr., executive engineer, Chrysler Corp.'s Advanced Projects Organization, Detroit, Mich.

Wiley V. Conover, director of sales, Autonetics, a division of North American Aviation, Inc., Downey, Calif.

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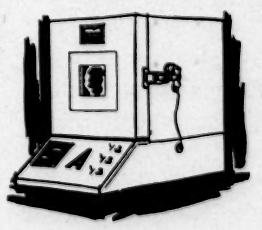

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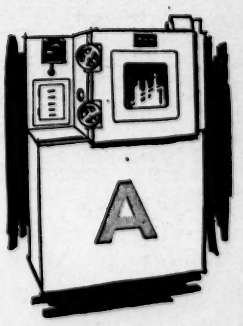

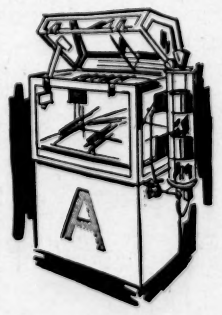

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LETTERS

Chart Explained

In a recent article, "Industry Probes Nuclear Pulse Radiation," in AVIATION WEEK (Aug. 8, 1960, p. 58) you show a curve on the first chart which implies that the thermal energy from a nuclear weapon is about 10^{13} calories per kiloton if the abscissa is in statute miles, or about 1.3 x 10^{13} cals/kt. if the abscissa is in nautical miles. This is inconsistent with the figure of 10^{12} calories per kiloton quoted in "Effects of Nuclear Weapons" U.S. AEC, 1957, paragraph 7.113. Having consulted several references I am still unable to resolve this discrepancy. I should be greatly obliged if you could do so for me, and, if possible, to quote the source from which General Electric obtained the information from which the chart was prepared.

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(Because of many similar inquiries, AVIATION WEEK is publishing below General Electric's answer.—Ed.)

The reference materials used in preparing my charts which you published in your article "Industry Probes Nuclear Pulse Radiation" (AW Aug. 8, 1960, p. 58), were Glasstone's "The Effect of Nuclear Weapons," 1957 edition, and Kaplan's "Nuclear Physics," 1955. The portion of my chart which describes how altitude detonations were taken came directly from Glasstone, but the data on high altitude conditions was computed from somewhat different criteria.

A nuclear explosion in space is quite different from the surface burst. Since there is no atmosphere, the thermal energy is emitted as a single, short burst. Because damage to the human being is not the primary concern, thermal energy may cause damage through various processes. Just as the short gamma pulse can produce a detrimental effect even though the delivered dose is quite small, thermal energy with low penetration power delivered in a short, intense pulse may cause equivalent damage at a lower integrated dose.

In accounting for this effect and to construct charts depicting range versus yield it was assumed that 80% of the total energy released in a fission explosion is emitted as thermal energy. Considering the various possible thermal damage processes which in effect increase the apparent source strength and after several calculations of damage thresholds based on color and material characteristics, it was arbitrarily decided to apply a safety factor of 10; that is, to increase the source term to 8 x 10^{12} calories per kiloton. This assumption served two purposes; it accounted for the increased effectiveness of the thermal energy emitted during a nuclear explosion in space, and it tended to deemphasize the relative effective range of the gamma pulse.

One should note at this point that the charts were prepared from unclassified material to show the effective ranges for the various products of a nuclear explosion. It was hoped that those familiar with nuclear explosions would readily recognize the simplification of technical content.

Perhaps it is well to note that a safety factor was also used in the calculation of the prompt gamma pulse spatial distribution. In this case the range was minimized in order to be conservative and to avoid the possibility of over-emphasizing the nuclear pulse problem.

It is not the purpose or intent of these charts to present precise data on nuclear explosions. The objective was to call attention to the nuclear pulse problem without overemphasizing it. The charts are sufficiently accurate for this purpose, but one should seek access to the classified literature for complete information.

JOHN R. CRITTENDEN
Product Specialist
Electronic Components Division
General Electric Co.
Owensboro, Ky.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

XM72 Grenade

As a devoted and consistent reader of your excellent magazine, I was most pleased to see your fine article about an item that is a source of considerable pride to all of us here at Hesse-Eastern, the Army's new XM72 rocket grenade (AW Jan. 16, p. 32). I do, however, feel that as long as the name of one company that was part of an excellent team of manufacturing subcontractors was mentioned, the names of the rest of the many participants in this development should also be made a matter of the record, for this item is directly an accomplishment of America's Industry-Ordnance-User Team.

The XM72 rocket grenade which was conceived by, developed by, and from a system standpoint managed by Hesse-Eastern, was under the successive direction of the Army Ordnance Missile Command's Army Rocket and Guided Missile Agency and Army Ballistic Missile Agency. The using service input was from the Infantry Board and the Infantry School, Ft. Benning, Ga., and the Arctic Test Board, Ft. Greeley, Alaska. Industry-wise, Hesse-Eastern was ably supported by an excellent team of manufacturing subcontractors consisting of: American Optical Co., Southbridge, Mass.; Bridgeport Brass Co., (Hunter-Douglas Division), Riverside, Calif.; Eastern Tool & Mfg. Co., Belleville, N. J.; Harvey Aluminum, Inc., Torrance, Calif.; Lamtex Industries, Farmingdale, N. Y.; Sprague Electric, North Adams, Mass.; and Zenith Radio Corp., Chicago, Ill. In the concurrent production engineering of this item during development, considerable additional assistance was afforded by the Ordnance Special Weapons Ammunition Command, Picatinny Arsenal, Ordnance Ammunition Center, Hercules Powder Co. which operates Radford Arsenal and Day & Zimmerman Co. which operates Lone Star Ordnance Plant.

The formation and effective use of a team of this type is really a story in its own right and represents, we feel, the pattern of America's true strength. This story we are not trying to tell; however, we do feel that all who have made significant contributions to the effort that resulted in a highly successful XM72 should be mentioned.

CHARLES B. WEEKS
General Manager and
Technical Director
Hesse-Eastern Division
Flightex Fabrics, Inc.
Everett, Mass.

Short-Haul Needs

An excellent suggestion for an extremely useful application of the $50 million balance in NASA research funds (AW Jan. 16, p. 37) is to channel a portion of this money toward development of a short-haul, local-service transport, or research of design principles necessary for such a transport.

Looking at the national transportation picture, it is evident we are not going to open the dam and tap the travel market of millions of highway users unless we make air transportation over relatively short distances faster, less costly, and much more convenient than it is today. The potential of this market is too staggering for most to comprehend. It follows that a very large part of this market will be going to more distant points via connecting carriers. The problem of not having the aircraft to do the job should be of as great concern to the large carriers, federal government, and traveling public as it is to the local airlines.

The time has long since passed when one could say it took less time to get to the major airport than it did to fly the en route time of the long haul. Development of the long-haul carrier has been rapid over the past few years. Development of the helicopter has also been good, probably because of design study contracts to aircraft companies by the military. Many aviation leaders are saying that perhaps the helicopter is the answer to the short-haul market. We may all have to agree to this unless development is begun on a fixed-wing, short-haul aircraft. There have been many aeronautical design ideas and discoveries over the years that are most applicable to the short-haul transport. Wing slats, speed brakes, fast center point refueling, the channel wing principle, and pre-loadable cargo containers to name a few.

Let's be objective. Are we trying to build an air transportation system for America? If so, and we want lots of people to put on the SSTs when they get here, then development of an aircraft that will do the job on the short haul is an absolute necessity.

WENDELL K. HOWELL
Local Service Captain
Detroit, Mich.